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Evolution of
AIR POWER*

General Carl Spaatz
Commanding General, *Army Air Forces*

THE year 1783 saw the first aerial ascent by man. The vehicle was a balloon, and it is strange that the military minds of the day failed to perceive in it an adjunct to their weapons of war possessed of unlimited possibilities. Andre Giraud de Vilette, the first passenger in a captive balloon, wrote to the *Journal de Paris* on 20 October 1783, that he "was convinced that this apparatus, costing but little, could be made very useful to an army for discovering the positions of its enemy, his movements, his advances, and his dispositions." Despite this clear statement of the obvious, the value of aerial reconnaissance was not fully recognized until 1914. It is a curious commentary upon the genius of Napoleon to note that he abolished the French Army's balloon corps which had been allowed to run to seed after a promising beginning during the French Revolution. If there had been a balloon observer at Waterloo, the period in history known as the Hundred Days might have ended at Versailles instead of St. Helena.

The Civil War in the United States was marked by aeronautical activity in both the Union and the Confederate Armies. The direction of artillery fire by balloon observers, the employment of antiaircraft artillery, the use of camouflage, and the erection of faked gun emplacements anticipated developments which were not to be made standard procedure in the military establishments of the world until much later. Despite such advanced operations, the Civil War use of balloons was very limited, and they were discontinued long before Appomattox. The Franco-Prussian War, which followed in 1870, made practically no military use of balloons. The French, however, did dispatch sixty-five from beleaguered Paris to carry mail and important personages, including Premier Gambetta, who escaped to prolong for a short time the war his country had already lost.

Although many military opportunities were missed during the nineteenth century through the failure of the armies to use aeronautical aids to reconnaissance, surface scouting continued to be capable of giving reasonably accurate intelligence until the mass armies, increased mobility, and increased fire power which came into being during the pre-World War I era rendered it inadequate. When trench warfare stopped all mobility of maneuver on the Western Front, it came as something of a surprise to the strategists who, before 1914, had pictured the coming conflict as a war of movement. In anticipation of shifting encounters, a substantial amount of military attention turned from balloons to heavier-than-air machines and guidable lighter-than-air machines of the semi-rigid or dirigible type. The great

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names of Wright, Farman, Curtiss, Rumpler, Zeppelin, and Schütte made international news during the first dozen years of the twentieth century, and as a result of the interest generated in aviation by their early experiments, the belligerants of 1914 entered the war with aircraft capable of functioning as instruments of strategic reconnaissance.

Air Power Development in World War I

It is unfortunate, from the standpoint of the military development of air power, that World War I was a war of movement for but a short time, and that freedom of maneuver ended when the Allies in the west faced the Central Powers along three hundred miles of trench work which stretched from Switzerland to the English Channel. As strategic reconnaissance, aviation in World War I enjoyed an independence which, had it continued, might well have hastened the maturation of the concept of air power as a co-equal military arm which operates most effectively, either as a tactical or strategic force, when organized as an autonomous entity under a supreme commander of all of a theater's military power. It was inevitable however, in view of the primitive nature of air power in 1914, that aviation should be made to subserve the ends of the land armies after trench warfare had removed the need for strategic reconnaissance and had placed a premium upon the observation of artillery fire and the performance of tactical reconnaissance. The stalemate which continued for years on the ground, and the slow campaign of attrition carried on by the naval forces blockading Germany set the stage for either side to win the decision through strategic air bombardment. Neither the Allies nor the Central Powers, however, possessed air equipment which would have been capable, by any stretch of the imagination, of carrying out such a mission. Supplying information to intelligence and staff officers became the routine tasks of the airmen, and the designation of "division aviation" was to be applied to aviation units almost to the time of World War II.

As the eyes of the armies, aviation was very successful. For the first time since the development of mass land forces the "fog of war" lifted, and commanders were again able to make decisions upon the basis of an observable situation. The result was increased fighting efficiency, but since almost throughout the war neither side won any clear cut aerial superiority, the benefits of aviation accrued about equal to the opposing armies. Aviation, however, gave an unexpected advantage to the Entente powers through improving the efficiency of surface weapons and increasing the daily expenditure of the materials of war. The rate of attrition was stepped up, adding to the effectiveness of the Allied blockade and increasing the importance of the superior productivity of the factories of England and the United States.

As the conflict proceeded, the performance of aircraft improved under the forced developmental programs imposed by war conditions. Single seater planes became sturdier, faster, more maneuverable and far better armed. The scout plane developed into a true fighter type.

Yet, although the mission of the scout was armed reconnaissance, its frequent participation in spectacular individual sky duels made it the object of world attention, and the tabulations of enemy aircraft destroyed did help morale, in truth there was as much of a stalemate in the air as there was on the earth below. Aside from increasing the rate of attrition, aviation in World War I merely added a third dimension to the area practicable for hostilities and made but slight contribution to the ultimate decision.

Gotha Attacks on London

The dirigible attacks on London were

strategic in concept, and during a three-year accelerated campaign, the Belgian based airships struck at targets throughout England with considerable effectiveness. At the height of the Zeppelin and Schütte-Lanz activity as many as a quarter of a million Londoners sought nightly refuge in the city's underground. But the development of improved fighter aircraft, and the advent of the tracer bullet put an end to this German attempt to break the stalemate in the air. The Gotha, a long-range bomber which had been given its operational trials in the Balkans, took over the Zeppelins' mission, and in May, 1917, London was attacked in daylight by a formation of them. Despite their limited capabilities, the Gothas were able to continue their raids with some degree of success, and in addition to disorganizing life in England's capital an appreciable amount, drew upon Allied air strength in France which had to provide the necessary air defense.

Allied air equipment had been developed almost exclusively to perform the duties of reconnaissance and observation. Although there was a growing awareness, fostered by air leaders like Brigadier General William L. Mitchell of the United States Army Air Service and General Sir Hugh M. Trenchard of the Royal Flying Corps, of the need for strategic air equipment, it was only in the last year of the war that any appreciable strategic bombardment was done by the Allies. Although some good results were obtained, particularly by the British Handley-Page bombers against Mannheim and Frankfurt, equipment limitations hampered Allied operations as it did the German. The best heavier-than-air bombardment aircraft of World War I were able to drop but half a ton of explosive on a target, and most bombers were capable of carrying but a few hundred pounds for short distances. The numerous bombing raids which were flown during the conflict had little effect on its outcome. The great land armies and the naval blockade decided the issue.

In America, aviation was a highly controversial subject during the two decades which separated World Wars I and II. The test bombing and sinking of the *Frankfurt* and the *Ostriedland* began the air power versus sea power debate that continued unresolved until the events of the recent war. The struggle for appropriations for military aviation went on from year to year ending only with the direct threat of World War II. Against the firm conviction of the Army Air Service leaders who believed that strategic bombardment would be decisive in a future war, the President's Aircraft Board headed by Chairman Dwight W. Morrow reaffirmed, in 1925, the status of military aviation as subservient to the needs of the army. In 1934, only ten years before Japan was to be bombed by B-29s, the War Department Special Committee on Army Air Corps, with the Honorable Newton D. Baker as its chairman, envisaged our primary needs in land based aviation as ". . . adequate air forces with our army to assist in repelling an invading force, which the Navy does not overcome, and to assist in land campaigns." But by providing material for speculation and further debate on the role of air power the wars in China, Abyssinia, and Spain intensified the pro and con discussions.

Military Aircraft in Ethiopian Campaign

In 1935 Italy marshalled the power of a modern military nation against the feeble defenses of feudal, primitive Abyssinia. The campaign was essentially political, and Mussolini could not risk a failure. Instead of the 120,000 troops with which Marshal Emilio De Bono had expected to operate, Il Duce ordered the campaign to be executed with ten Italian divisions. When De Bono had received

126 of the 350 aircraft he had calculated as necessary for the support of his ground forces, the Italian Army, on 3 October 1935, began its advance against the Negus. In November De Bono was replaced by Marshal Pietro Badoglio, and by the second week in May 1936, the Ethiopian Empire had been defeated. Although the poorly equipped and ill trained Ethiopians presented to the Italians an opposition which can hardly be described as formidable, the logistic problems in the campaign were substantial, and the nature of the terrain made maneuver and liaison extremely difficult. In view of the obstacles to an early victory, the ability of the Italians to conclude the Ethiopian Campaign in eight months represented a considerable military achievement.

But to the man in the street, the Italian victory did not appear as an impressive performance at all. He felt that the Italian bombardment and attack aviation should have been quickly decisive against a foe whose only air defense at the outset of the war consisted of twenty-four antiaircraft cannon and twelve inefficient airplanes. When the fighting continued for three-quarters of a year the debunkers of air power won many converts to their cause.

In the eyes of objective military observers, however, the Italians used their aviation very well. There was literally no strategic bombing mission in Abyssinia, and there was very little need for independent air activity. Since its task was purely tactical and cooperative in nature, the Italian Air Force was not hampered in its operations by its subordination to the ground forces. Good organization prevented air units from being used in an inefficient and piecemeal fashion, and what independent action the Italian Air Force did undertake was merely the bombardment of tactical targets which had been located by aerial reconnaissance and attacked upon Air Force initiative. While aviation was used in Abyssinia in much the same manner as it had been used in World War I, the ease with which the Italian victory was achieved was largely the result of the lack of opposition to aerial reconnaissance. Those onlookers who condemned air power as relatively ineffective did so because they committed the folly of thinking that the Ethiopian Campaign presented a parallel situation to what would obtain in a war between industrial powers.

Shortly after the Japanese began the Battle of China, in July 1937, Japanese bombers attacked over a wide area. The targets were commercial and industrial centers, and the Japanese purpose was to destroy Chinese production and to break the will of the population to resist. It is difficult to evaluate the effectiveness of these attacks since they were not sustained long enough to have a measurable impact upon the conflict. It is easy to surmise, however, that the Japanese air units operating in China were brought to heel by the ground commander in charge of the campaign and henceforth restricted to tactical operations. This surmise becomes even more plausible when it is seen that the subsequent Japanese use of aviation in China prior to 1940 was as an afterthought to unsuccessful or indecisive action. Japanese troops had fought for three bloody months before Shanghai fell on 13 November, 1937. When air power was finally used, the Chinese retreat became a rout. The Chinese defenders of Chengchow were successful for ten months against the Japanese ground operations, but when massed aerial bombing was at last resorted to, the city fell on 25 October, 1938. This misuse of aviation together with Japan's failure to launch a systematic and concentrated strategic bombardment campaign against the Chinese turned the conflict into a war of attrition during 1939.

Modern Air Power Tested in Spanish Civil War

Both politically and militarily, the Spanish Civil War which began in July 1936, was the most significant of the minor struggles which foreshadowed World War II. Russia contributed substantial military assistance to the cause of Republican Spain, and Germany and Italy backed the followers of Generalissimo Franco. It was transport units of the *Luftwaffe* which carried 18,000 Fascist troops from Morocco to Spain and saved the insurrection from prompt suppression. Despite the interest of the "sponsor" powers in the conduct of the Spanish War, however, no air forces of the size and efficiency of those which operated in World War II were ever seen on either side. A year of fighting had already gone by when P. Mikhailow, a Russian observer, reported that "Great numbers of planes were particularly employed in the Saragossa Operation. There were instances when the insurgents had as many as eighty planes in the air at a time, with the Loyalists using similar numbers of planes." As the war progressed, aviation was used with increasing frequency and in growing quantities. Nevertheless, ninety aircraft were thought to constitute a major aerial effort even during the Madrid campaign of July 1938.

There are two main reasons why aerial warfare over Spain assumed no greater proportions than it did. First, Franco did not have to fight for aerial superiority. It was handed to him in the form of German and Italian equipment. Although Russia tried to offset this advantage to some extent by supplying the Loyalists with the latest types of Russian fighter craft, the Soviets were either unwilling or unable to make the production effort which would have brought about parity in the air over Spain. Since the Civil War never became sufficiently critical to cause the sponsoring powers to enter the conflict in force, the size of the military operations, both in the air and on the ground, were limited on one hand by Russia's failure to increase its aid to the Loyalists, and on the other by the Axis powers' willingness to participate only to a degree which would assure a Franco victory, provide their own general staffs with operational data, and supply their armed forces with cadres of combat-trained personnel.

The second limiting factor in the use of air power in the Spanish Civil War stems from the nature of the struggle. Both the Fascists and the Republicans were fighting for control of the country, and, as a result, the destruction of cities and production facilities by either belligerent would have produced for the attacker an immediate advantage and a subsequent liability, in the event of victory, directly proportional to the success of the attack. The Fascists, therefore, tended to limit their air activity to cooperative operations with their ground forces, while the Loyalists, equipped largely with fighter craft, fought, in the main, defensive air battles against their numerically superior enemy. As might be expected under such circumstances, the Loyalists were credited with shooting down more aircraft than were Franco's airmen. But the mission of air power is to attack, and by their stubborn defense the pilots of the Republic only postponed their eventual defeat.

Although many military observers witnessed the war in Spain, their conclusions with regard to the war in the air varied widely. In 1936 there was very little military air experience along lines other than those of aerial reconnaissance and cooperative operations with ground forces. The fighting during the two years which followed did not greatly change this situation. Many of the military observers reporting on the aerial phases of the civil war gave frequent indications in their

writings that they had no idea that air power might be used as anything but an adjunct to surface power. Furthermore, the special conditions, referred to above, imposed by the nature of civil war, together with the limited capabilities of the air equipment used and the inequality of the opponents, helped to cloud the picture which military leaders had hoped would show the true role of air power in modern war. One military observer, writing in the French publication *Revue de l'Armée de l'Air* in February 1937 stated, after observing the unfolding of the air action in Spain, "If aviation is to be . . . an important part of military action, its essential weapon should be as simple as that of the troops; i.e., as the gun of the foot soldier." As an example of a disparate point of view, a plea for the construction of complex military bombardment aircraft made by General H. H. Arnold in the same year might be cited. "The war over Spain," said General Arnold, "affords an excellent example of what happens when commercial types are converted to military use. A considerable number of German-built commercial transports appeared over the battlefields during the past year in Spain; in the roof of the cabin, a round hole had been cut and a gun turret had been installed. That apparently, in the minds of the transformers, had made it a military plane. There were no guns in front. The pilots had poor visibility. The bombs were apparently to be just kicked out of the door. . . . The Russian planes with great ease began to knock down these converted commercial bombers."

Certainly there were valid lessons concerning the employment of air power derived from the Spanish war. Despite the fact that some observers saw an indication that retractable landing gear was undesirable on fighter aircraft and that air power could be wielded most effectively by large numbers of small light biplanes capable of a top speed of 250 miles an hour, some clear, intelligent reports may be winnowed from the chaff which predominated.

C. Rougeron, a French aviation expert of unusual ability and perceptiveness, after observing Franco's use of aviation to deny freedom of water transport to the Loyalists, made this searching statement: "In two years the airplane has won a place beyond all question, at the head of the means employed for the control of maritime communications. It is readily understood that during the World War its still inadequate performance prevented it from playing such a part. But in view of the machines offered by the techniques of the past ten years, the stubbornness displayed in wishing to reduce to a purely naval problem a question which manifestly pertained to the aerial domain is one of the finest examples of the errors which may be committed when one refuses to change his course until experience has rendered its judgment.

"The airplane is the most efficient device for the interdiction of maritime commerce, on the high seas or in port, whether it is employed or not for the benefit of the party who holds what may still remain of the mastery of the seas."

Germany Hid Air Secrets of Spanish War

The German dive bombing of sensitive points on Loyalist rail lines provided the material for another valid lesson on the employment of air power taught by the Spanish War. Only the most alert of the military observers appreciated the full significance of the success of these operations, because after the Germans proved the effectiveness of the technique to their own satisfaction, the attacks were discontinued and kept from the eyes of the world until Hitler plunged the world into war in 1939.

That bombers could not operate in the

daytime without fighter escort became apparent to some onlookers during the course of the conflict, while it became evident that fighters could increase their effectiveness by flying in mutually supporting elements of three or four. Attack aviation, it was soon learned, was most effective when operating against troops and matériel changing position, and aircraft, shooting armor piercing projectiles, it was discovered, were effective against tanks. The long-held belief that troops in position were highly vulnerable to aerial attack was shown to be false, while the artillery stood out as one of the tactical objectives most easily hit from the air.

Advocates of strategic bombardment, both in this country and in Britain, found little to support their views as a result of the aerial warfare in Spain. High altitude horizontal bombing was so erratic that many observers concluded that only dive bombing could produce precision results. The unwillingness of either side to destroy cities and production facilities, which has been noted earlier, militated against experimentation in high altitude operations, and even the Fascist bombing of Valencia, Barcelona, and Madrid employed but a small number of aircraft and in a haphazard manner.

There have always been military men who attempt to predict the nature of future conflicts by carefully picking over the lessons of the most recently concluded war. This attempt to mirror the future in the past produced the disastrous tactics of the British Army in the French and Indian War, the French catastrophe in 1870, and the Maginot Line of 1940. Fortunately, it also produced the *Luftwaffe*.

The opinion that air power was properly an adjunct to surface power and that air power was incapable by itself of being decisive in war was held by most military minds before the events of World War II proved them wrong. The *Luftwaffe* was geared to the flywheel of the Wehrmacht, and as a result, Germany began World War II with an air force which appeared to be the greatest vehicle of air power in the world, but which actually proved to be capable of providing no more than the third dimension of a *blitz* campaign. If Germany had understood the concept of strategic bombardment and had produced an air force capable of sustained independent action World War II might well have ended differently.

Until Dunkirk, the *Luftwaffe* had things its own way. The Polish Air Force was annihilated within three weeks of the commencement of the campaign. In Norway, transport units of the *Luftwaffe* carried the advance guard of the invading force while Stukas assured the success of their landings and scouted the routes the German armor took in the rapid conquest of the country.

In the Flanders campaign which followed, the Dutch air force was disposed of in three days, and as in Norway, *Luftwaffe* transports carried the troops which invaded the Netherlands. In Belgium, Fort Eben Emael was taken by engineer troops who were crash-landed within that stronghold, making the Albert Line untenable. The famous Sedan breakthrough was prepared by the *Luftwaffe*, and it was the *Luftwaffe* which protected the flanks of Guderian and Rommel, permitting them to exploit their initial success without danger. But at Dunkirk, where the British stood with their backs to the sea, the German Air Force ran into serious opposition for the first time. During the nine days of the great evacuation the Germans lost a quantity of aircraft which some sources place as high as 400, while the Royal Air Force itself lost but 100 and succeeded in covering the embarkation of the trapped British and French troops. This demonstration of the defensive ability of the Royal Air Force Spit-

fires and Hurricanes should have given Goering ample warning that he could not win the Battle of Britian with aircraft he possessed or with the plan he had devised. But warning or no, the *Luftwaffe* fumbled its great opportunity to bring the war in Europe to an early end and absorbed the first decisive defeat it had ever known.

There are six reasons why the *Luftwaffe* failed in its attempts to smash Britain from the sky. First, the lightly armed and armored Heinkels, Dorniers, and Messerschmitts were unable to provide any semblance of self defense against the eight gun fighters of the RAF. Designed as tactical aircraft, they were incapable of carrying the heavy bomb load called for by strategic operations, and they were not equipped for precision bombing. Second, the German fighters failed to evolve adequate escort tactics. Ignoring one of the valid lessons of the Spanish War, the *Luftwaffe* fighters flew in mass close support rather than in general support in units of three or four aircraft. Third, the Germans failed to evaluate the defensive strength of the RAF and thought that aerial supremacy over Britain could be gained through aerial combat, the bombing of airdromes, and a few scattered attacks on British aircraft factories. What worked in Poland and Holland ought to work against England, reasoned the Germans. Events proved how wrong they were. Fourth, Goering, having devised what might be called a tactical plan to achieve a strategic end, failed to carry out properly his inadequate scheme. The objectives of the three phases of the Battle of Britian (knocking out the perimeter airdromes along the eastern and southeastern coast of England, knocking out the interior airdromes centering around London, and the destruction of London) were not achieved at the time called for by Goering's timetable, yet, leaving unfinished business, he attempted to proceed according to plan. Fifth, the German Air Force, by attacking convoys and port installations, diverted a substantial portion of its strength from its main task: the defeat of the Royal Air Force. Sixth, the *Luftwaffe* was not organized to carry on a sustained air offensive. After the brief Polish campaign it had been given time to regroup and to replace equipment and personnel. The same was true after the Flanders campaign. But the Battle of Britain lasted for over three months, and when the German Air Force withdrew, it was exhausted.

Air Power Disregards Perimeter Defense

The strategic air concept, kept alive by British and American air leaders despite widespread opposition during the years which preceded World War II, is both simple and profound. Before the advent of modern air power the destruction of the enemy's armed forces was the foremost objective of military and naval action. Beyond this primary objective, attrition was the main concern of naval forces while the capture of enemy territory and matériel concerned the land forces. Air power, when it came, provided a weapon able to disregard a nation's perimeter defenses and to strike at the very heart of its military strength—its war industry and its war economy. When the enemy's heart action stops, his military power dies.

Strategic bombardment is the most powerful weapon of war thus far produced, because it embodies three of the principles of war to a uniquely high degree. The first of these principles, *the principle of mass*, is fulfilled by air power's ability to focus its total strength, which may be based over a wide area, upon a single target. The 1500 plane attacks on Berlin, flown by the Eighth Air Force in 1944, illustrate this quality. The second principle, *the principle of objective*, is actualized by air power through

its capacity to select for destruction those targets most vital to the enemy's war economy. The ability of Allied strategic bombardment in Europe to select and destroy a substantial portion of Germany's aircraft production facilities, synthetic oil plants, and armament factories clearly demonstrates the embodiment of this principle. The third principle, *the principle of economy of force*, is incorporated in air action through air power's ability to bypass targets of secondary importance and strike at those objectives which give the greatest military reward in return for the force expended. The Eighth Air Force's having the option to neglect the rail yards at Erfurt, for example, and to fly on and hit the oil plants in the Leipzig area exemplify this third principle which is, in effect, a corollary of the second.

In America, the strategic concept dominated Air Force thinking throughout the two decades between the two world wars. In 1921 General "Billy" Mitchell struck the keynote with his prophecy: ". . . the only way that a war can be brought to a successful conclusion in case of determined resistance is to carry the war into the enemy's country; and in modern times this may mean attacking his whole population, means of production and subsistence." In the 1930's the weapon with which to execute the strategic concept came into being with the first model of the B-17. This aircraft, which was to undergo extensive modification in the years immediately preceding World War II and during the war itself, was designed for daylight precision bombardment from high altitude.

When war came, the American doctrine of daylight bombing was looked upon with some misgivings by our British allies who had abandoned daylight bombing early in the conflict and turned to night operations. But the Royal Air Force was in basic accord with the U.S. Army Air Forces on the matter of strategic bombardment despite divergence of method. This very difference in bombardment technique worked to our mutual benefit when the Casablanca Directive of 1943 established the full scale strategic bombing program. Round-the-clock operations were possible with a British air force trained in night tactics, and an American air force able to attack by day.

Request for Massive Air Offensive

On 10 June 1943, as a result of the Casablanca Directive, "The Combined Bomber Offensive Plan" was approved by the Combined Chiefs of Staff, and the tremendous effort which had forged the American air weapon began to pay military dividends. Although on 17 August 1942, twelve B-17s had struck the Eighth Air Force's first blow with an attack on an enemy objective in occupied France, the need to use what aircraft were available against German submarine pens and in the crucial "Torch" operation in North Africa had left German industry practically immune from bombardment. The Casablanca Directive, implemented by "The Combined Bomber Offensive Plan." enlarged the scale of the air offensive and called for the "destruction and dislocation of the German military industrial and economic system and the undermining of the morale of the German people to the point where their capacity for armed resistance is fatally weakened."

The first task was the destruction of the German fighter defense. This vicious battle began in July, 1943, and culminated with "The Big Week" of 20 February 1944, when six days of perfect weather permitted a continuous assault on the widely dispersed German airframe factories and assembly plants. Although the German aircraft industry recovered from the effects of this massive blow, the Allies controlled the air over Europe during the remaining fourteen months of the war, and German industry and transportation were exposed to a series of air attacks

which carried the Reich to the point of economic collapse.

During the first four months of 1944, the attacks on the German aircraft industry were continued, and in May and June the forces which could be spared from the attacks on communications and transportation in preparation for the invasion of continental Europe began the offensive against German nitrogen and oil plants. Once the troops were securely established in France the campaign against the German chemical industry began in strength, and, within six months, the output of aviation gasoline and nitrogen was cut ninety per cent. By January 1945, five months after the initiation of the offensive against Germany's transportation system, carloading had been reduced in volume by seventy-five per cent, while the Ruhr's output of steel decreased fully eighty per cent as a result of a ninety-day campaign begun in October.

Strategic Bombing Forecast End of Germany

From December, 1944, on, the German war economy declined in all its departments. Albert Speer, Reichsminister of Armaments Production, interpreted the handwriting on the wall when he reported on 15 March 1945 that "The German economy is heading for inevitable collapse within 4-8 weeks." Unfinished components in the production pipe-lines had permitted the emergence of finished munitions up to that time, but when inventories were exhausted further production was almost impossible. Although formal hostilities did not end until 8 May, the strategic bombing effort was concluded on 16 April. The validity of the concept which held air power's independent mission to be capable of contributing decisively to victory had been demonstrated.

Although air power is, of course, a continuing and dynamic force in world affairs, the evolution of air power reached its culmination in World War II when Japan surrendered unconditionally with her armies undefeated in major engagements and in control of nearly three million square miles of land populated by 500,000,000 people. The six months which preceded VJ-day were characterized by low level incendiary attacks by B-29s on the Japanese homeland. Our supremacy in the air, which had been achieved by the end of 1943, and maintained continuously from that time onward, was exploited so thoroughly that Japan's war economy was paralyzed. The United States Strategic Bombing Survey calculated that both area and precision bombing were responsible for reducing the pre-attack capacity of Japanese oil refineries eighty-three per cent. Similarly, aircraft engine plants suffered a seventy-five per cent production loss; airframe plants, sixty per cent; electronics and communications plants, seventy per cent; army ordnance plants, thirty per cent; naval ordnance plants, twenty-eight per cent; merchant and naval shipyards, fifteen per cent; light metals, thirty-five per cent; ingot steel, fifteen per cent; and chemicals, ten per cent.

The Japanese populace suffered a severe lowering of morale as a result of the realization that the Japanese armed forces had lost their ability to defend them from the impact of the aerial attacks which were demonstrating, before their very eyes, the hopelessness of further confidence in victory. So strongly did the B-29 attacks effect the Japanese people that just prior to VJ-day sixty-four per cent of the populace felt personally unable to go on with the war.

In our victory over Japan, air power was unquestionably decisive. That the planned invasion of the Japanese home islands was unnecessary is clear evidence that air power has evolved into a force in war co-equal with land and sea power, decisive in its own right and worthy of the faith of its prophets.

The emphasis which today is being placed on research and development by the Army Air Forces points to the fact that air power continues to change and progress. Certainly the operational application of air power will change. It may be, for example, that massed bomber formations will soon be as obsolete as the Macedonian phalanx. But as long as air power remains the vehicle for some sort of destructive missile, the strategic concept as it is now understood will remain valid.

The strategic concept is so obviously a vital consideration in the formulation of national defense measures, that air power and its primary vehicle, the Army Air Forces, must be given whatever support is necessary to maintain strategic offensive readiness with which to answer the actions of any future aggressor. It is a conviction widely held among military thinkers that if there is to be another war, it will begin with a strategic aerial attack launched in as great strength as the aggressor dares commit to achieve his objective. The United States has twice thrown its military might into a world struggle to help decide the issue in favor of the forces of freedom. Since America is today the leading power in the world, any first class nation which shatters the peace will do so by first attacking us in an effort to eliminate at the outset the participation of our armed forces. The grave responsibility that is placed upon the Army Air Forces is readily apparent.

An Air Force Second to None

If the Army Air Forces is to be able to meet this responsibility it must possess an air force in being capable of immediate actions with weapons second to none. An air force thus constituted must have adequate personnel thoroughly trained in the use of air weapons procurable as the result of a vigorous program of research and development, and the existence of a strong, readily expansible aircraft industry. Present planning indicates that a minimum of 400,000 officers and men is needed for our proposed air force in being. The Air Training Command together with the Air University, the Air Institute of Technology, the School of Aviation Medicine, civilian academic institutions, and training units within the operational organizations themselves can provide the necessary training and maintain the acquired proficiency. The Office of Research and Development is monitoring a program which is being carried out by the National Advisory Committee for Aeronautics, the Navy, the Ground Forces, the aircraft industry, the laboratories of academic and technical institutions, the research and development facilities of the Army Air Forces itself, and, in the case of certain aspects of guided missiles research, the Signal Corps and the Ordnance Department. In addition to its activity, in aerodynamics and allied subjects, the Army Air Forces is keenly interested in furthering a program for industrial mobilization which is currently under discussion.

It is obvious that a program to provide for national air defense such as that envisioned by the Army Air Forces is expensive, but the events which highlight the evolution of air power have convinced a great many thinking Americans that air power provides the greatest amount of defense procurable for their tax dollar. The realization of this truth must be spread so that the Army Air Force will receive the support it needs, for in the evolution of air power, as in the evolution of man, an unstable world permits only the *survival of the fittest.*

The Logistical Division

Colonel A. W. Pence, *Corps of Engineers*
Commandant, School of Logistics, Command and Staff College

The views expressed in this article are those of the author and not necessarily the views of the War Department. Policies regarding the Logistical Division have not been firmly established or indorsed by the War Department.

Need for a Logistical Team

WHAT would you think of the chances of a college which started the varsity football season with a team which had never been together on the practice field, and whose members had never met until they gathered together on the forty yard line at kick-off time? The answer is obvious. It might have the best players in the world, but it would certainly have a tough time and lose a lot of ground initially.

Yet nevertheless, that is precisely what our Army has done with regard to its great logistical team in every war we have fought to date, including World War II.

First, let's look at the players—the various service headquarters that call the logistical plays and the service units which carry them out. In peacetime there are no communications zone or section headquarters either active or in the mobilization plan. Routine operations show little resemblance to wartime problems. There is no T/O&E service unit higher than the regiment. Most service units are of battalion, company, detachment and team size who never get a chance to train as part of a big team. In maneuvers, even the minor logistical problems are often omitted and furious combat attacks are launched with blithe disregard of actual logistical support. So during the practice season our players never play the game. They seldom work together, and they often do not even have a quarterback or a coach to put on skull practice, to figure out a line up or to plan a few plays.

What do we do when game time approaches—the big game where one good licking puts you out of the league? You know the answer. We improvise. We hastily draw up a table of organization (or maybe we don't worry about a line-up). We man the headquarters with whoever happens to be available, without too much regard to experience or prior training. We dump several hundred unbalanced service units in the lap of this group of strangers. There is little coordination, little standard operating procedure, and little time to do much about it. The game must go on.

And does this so-called team lose ground initially? It most emphatically does. The record of those early landings in both the Atlantic or the Pacific tell the story. The confusion, the lost motion, the misplaced supplies, the wasted transportation, the lack of service units to do things, the lack of plans, were appalling. Vitally needed support was missing while fate hung in the balance, because the logistical team was trying to get its feet on the ground. Trying desperately, as men will try only when their lives depend on it, but struggling under the terrific handi-

caps of inadequate organization, inadequate training, inadequate equipment and inadequate plans.

History of Development

General R. L. Maxwell, then G-4 of the Army, after an inspection of the Pacific in late 1944, recognized the crying need for improvement. He, therefore, directed the Command and General Staff School to prepare a study for a logistical unit, which would be organized, trained and equipped to furnish logistical support to large combat units such as the corps and armies. It should be prepared to set up or take over a base, a base section, or even a small communications zone and operate it.

Such a study was prepared in early 1945 and envisaged two units, primarily for communications zone use, a logistical division of approximately 26,000 troops to support a reinforced corps, and a logistical corps of approximately 67,000 troops to support an army. The study was circulated for comment in the War Department and the theaters. It found wide acceptance in principle, but it was thought that the unit was too large and inflexible, and contained units which might not be needed in some situations. There were many other detailed comments.

All comments were studied, and in October 1945, the Command and General Staff School came up with a revised organization called the Logistical Division, Mark II, which carried an organic strength of 15,802 and incorporated the concensus of the comments. The term "logistical corps" was dropped, and support of large units was achieved by expanding the logistical division. The basic principle was established that the organic strength should contain only those units which would always be needed in any situation where the logistical load was at least as great as the support of a reinforced corps. Additional units would have to be added to meet any specific situation above this minimum. For example, there are a headquarters, a headquarters battalion, truck companies and depot companies in the organic division, because those units will always be needed. But there are no port troops, no railway troops and no large numbers of truck or depot companies, because these may or may not be needed. If the specific situation in which the division is to be employed shows the need for all or part of these units they will be added for that situation only.

The 16,000 man organic division is regarded as a trained indispensable nucleus to which other units will be added when actually needed. The headquarters battalion is purposely made large, but the headquarters itself and the services are kept small pending the time that the local situation is known and the nature of the expansion can be determined. The organic nucleus will furnish the organizational structure, the standing operating procedures, the plans, the team work and the know-how upon which an organization four or five times the size of the organic division can be built. The organic division is to be regarded as the basic unit of the combined services, the smallest independent unit which contains all of the principal services. It bears the same relation to the combined services that the infantry division does to the combined arms.

This organization was then field tested by the Continental Base Section in the European Theater of Operations for six months in 1946, in the course of their normal occupation duties. Their response and that of the theater was a strong indorsement of its suitability with certain minor changes. After further study in the War Department, the Command and Staff College has now been directed to come up with a Logistical Division, Mark III, including:

a. Draft of the Tables of Organization and Equipment.

b. A field manual to cover the organiza-

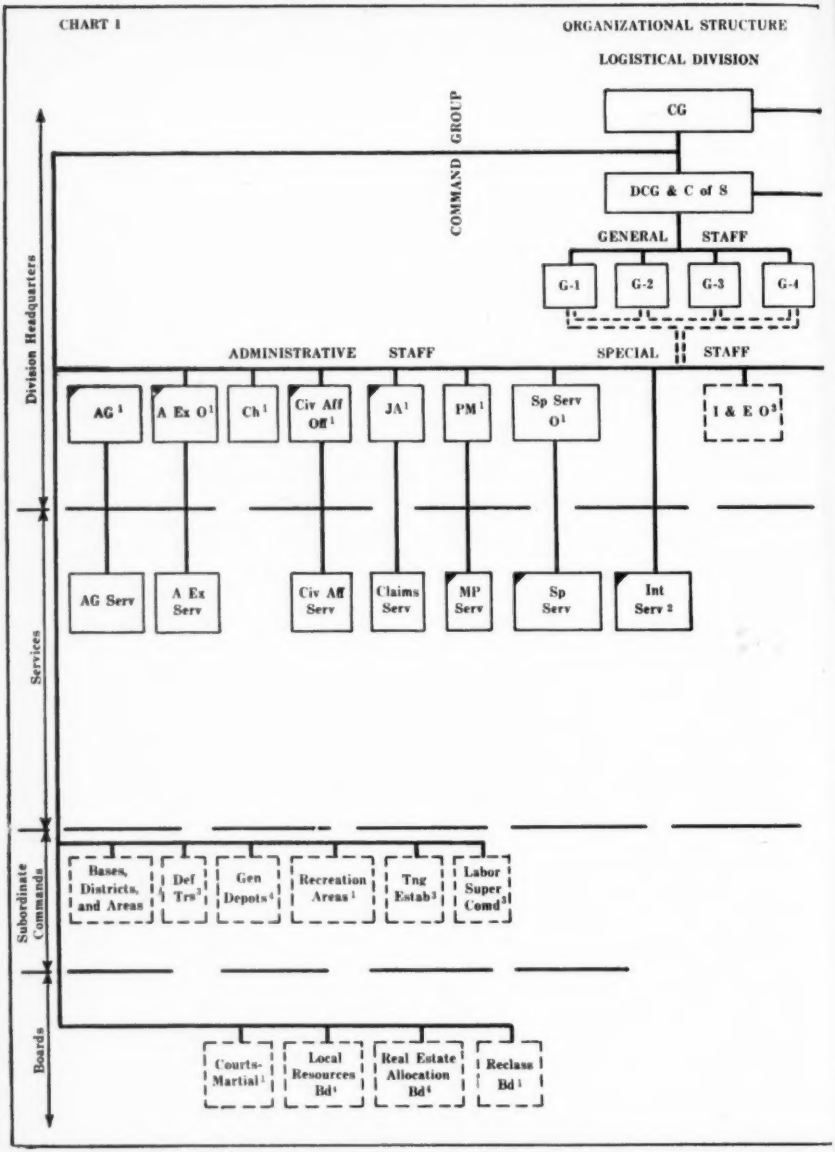
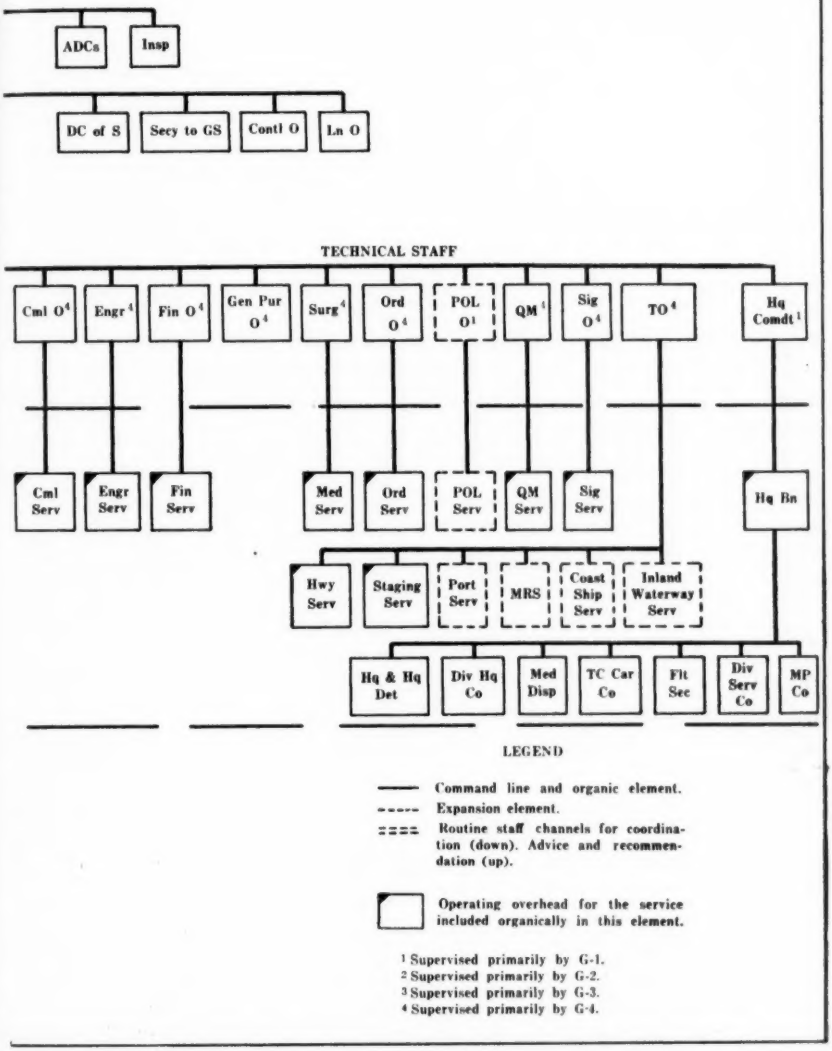


CHART 1
ORGANIZATIONAL STRUCTURE
LOGISTICAL DIVISION
Division Headquarters
COMMAND GROUP
CG
DCG & C of S
GENERAL STAFF
G-1
G-2
G-3
G-4
ADMINISTRATIVE STAFF
SPECIAL STAFF
AG 1
A Ex O 1
Ch 1
Civ Aff Off 1
JA 1
PM 1
Sp Serv O 1
I & E O 3
Services
AG Serv
A Ex Serv
Civ Aff Serv
Claims Serv
MP Serv
Sp Serv
Int Serv 2
Subordinate Commands
Bases, Districts, and Areas
Def Trs 3
Gen Depots 4
Recreation Areas 1
Tng Estab 3
Labor Super Comd 3
Boards
Courts-Martial 1
Local Resources Bd 1
Real Estate Allocation Bd 1
Reclass Bd 1


ADCs
Insp
DC of S
Secy to GS
Contl O
Ln O
TECHNICAL STAFF
Cml O[4]
Engr[4]
Fin O[4]
Gen Pur O[4]
Surg[4]
Ord O[4]
POL O[1]
QM[4]
Sig O[4]
TO[4]
Hq Comdt[1]
Cml Serv
Engr Serv
Fin Serv
Med Serv
Ord Serv
POL Serv
QM Serv
Sig Serv
Hq Bn
Hwy Serv
Staging Serv
Port Serv
MRS
Coast Ship Serv
Inland Waterway Serv
Hq & Hq Det
Div Hq Co
Med Disp
TC Car Co
Flt Sec
Div Serv Co
MP Co
LEGEND
Command line and organic element.
Expansion element.
Routine staff channels for coordination (down). Advice and recommendation (up).
Operating overhead for the service included organically in this element.
1 Supervised primarily by G-1.
2 Supervised primarily by G-2.
3 Supervised primarily by G-3.
4 Supervised primarily by G-4.

tion and employment of the logistical division.

Organizational Structure

Let us examine the organizational structure of this proposed unit. (See Chart 1.) The Commander is a Major General because he will have anywhere from 16,000 to 100,000 men under his command. The Chief of Staff, a Brigadier General, is also the deputy commanding general. Many occasions will call the commander away from his unit to coordinate with the supported forces, or to confer with communications zone headquarters, and a deputy must function during this absence. They are assisted by a standard general and special staff organized on the same pattern as those of a combat division, corps and army. This is important, for these are the units normally supported and similarity in staff organization expedites the transaction of business.

The command line runs from the commander directly to the special staff sections and to the headquarters commandant. The general staff supervises and coordinates the special staff but does not command it. There are seven administrative sections supervised primarily by G-1. Certain intelligence services are supervised directly by G-2, an information and education section is supervised primarily by G-3 and the nine technical service sections are supervised primarily by G-4.

Most of the special staff officers have dual functions. First, they are staff advisers to the commanding general and the general staff, and second, they command the troops of their services. This second is a most important function, for the major troop strength of the logistical division lies in the services and thus the division commander functions largely through his chief of service.

Chart 2 shows the organization of a typical service. The service chief, with such staff as is required by his function as a special staff officer, is located in the special staff section. The operating overhead is normally a standard Table of Organization and Equipment group headquarters which controls the field operations of the various battalions, companies, and detachments which comprise the service. Thus the staff section coordinates with the other sections of division headquarters and prepares over-all policies and directives for the conduct of the service. The operating overhead supervises the execution of these policies and directives by the operating troop units. The operating overhead was found very essential in practice from several angles. First, it kept the size of the division headquarters fixed within reasonable limits, regardless of the number of troops involved. Second, it provided a unit trained and equipped to look after the needs of the numerous small companies, detachments and teams of which a service is normally composed. Third, it improved efficiency by providing a unit whose sole mission was to insure prompt and complete compliance with policies and directives. Fourth, it could be located at the best point for superintending operations without being tied to the location of headquarters. Exceptions to its use are found in the small or local services like the claims or adjutant general in which the operating overhead is provided by the staff section.

The headquarters battalion is organized, trained and equipped to provide all the services necessary to make the headquarters administratively self-supporting and to provide service for official visitors (quite a large problem) and miscellaneous teams, visiting groups and units which may be located near division headquarters. As shown on Chart 1 it consists of seven elements and can furnish clerical help, mess, billets, supply, medical and dental assistance, utilities, guard, and transportation by car or plane. It should be able to handle a group twice the size of the organic headquarters either in a city

or in the field. This is necessary, because, as has been explained, it is necessary to expand the troop list, and, therefore, the headquarters in order to meet any specific situation.

Organic Troop List

The troop list for the organic division is still under study and is not based on the latest T/O&E's. The headquarters contains 100 officers and 250 warrant officers and enlisted men. Most base and advanced sections in the major theaters in the past war ran from 150 to 300 officers, but the 100 is sufficient for organization, training, movement and initial operations. As stated above, the headquarters battalion is large, because we know it must support an expanded headquarters, and the nature of that expansion is immaterial to the duties discharged by the headquarters battalion. The services contain sufficient troops for the interior administration and movement of the organic division and a few key units which will always be needed by the division in any situation although there are probably not enough of each kind of unit to do the required job. For example, the transportation service contains two truck battalions, not because this is all it will ever need, but because this is sufficient to start operations and to form a nucleus for expansion.

Expansion

This brings us to the matter of expanding the organic division to enable it to function effectively in a specific situation. An estimate of the situation will establish the requirements of the logistical load in terms of the supply, evacuation, transportation, and services needed. Field Manual 101-10 shows the capabilities of the various types of service units. A simple computation, heavily influenced by a study of local conditions and future plans, by the expert opinion and advice of the chiefs of service, and by the actual availability of additional service units, will show what additional troop units should be requested, including both operating troops and operating overhead. Perhaps study will show that expansion of certain elements, such as headquarters sections, can be better achieved by adding personnel than by adding new Tables of Organization and Equipment units. In this case, Tables of Distribution must be prepared to be used as basis for requesting individuals from the theater bulk personnel allotments.

The basic structural organization of the organic logistical division, shown in Chart 1, should be maintained in making the expansion. Normally, new units are added to the existing elements or sub-elements of the organic division. However in some cases, due to local conditions, it may be necessary to create new elements or sub-elements of the headquarters or services such as, let us say, a petrol, oil and lubricants (POL) section in headquarters, or a POL service, or a port service. In some situations, however, it becomes necessary to create subordinate commands or boards which pertain to the command as a whole and are not properly subordinate to any one particular service. Chart 1 shows examples and the place of such elements in the organizational structure. For official command, they report directly to the division commander but normally, just like the services, they come under the control of one or another of the G's for primary supervision. The necessity of creating any, or all, of the elements shown, or adding others, will be dictated by the situation.

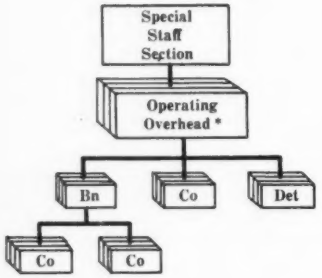
Generally speaking, the fewer new elements created, the smaller will be the required span of supervision of each G, and the simpler will be the organization. Also, generally speaking, service installations located in the territory of subordinate commanders remain under the operational control of the chief of service, although

they may come under the control of the subordinate commander for local administration such as discipline, protection, and local utilities, transportation, and services.

Typical Example

A study was made at the Command and General Staff School of the expansion required to fit the Logistical Division, Mark III to two typical situations, "A" and "B." Both situations assumed that the logistical division was used to operate an advance section in a portion of the

CHART 2
TYPICAL SERVICE
LOGISTICAL DIVISION



* In small services operating overhead is included in the Staff Section.

theater of operations cut off by the ocean from the remainder. Detailed assumptions were made as to local conditions, enemy damage, ports, lines of communications, etc., similar for the two situations. In situation "A," the advance section was giving full support to 135,000 troops (including a reinforced corps and air units in contact with the enemy) plus partial support to 252,000 prisoners of war, patients, allies, civilians, etc. In situation "B," the advance section was giving full support to 377,500 troops (including an army of three corps, and air units in contact with the enemy) plus partial support to 623,500.

The following points are of interest. It was necessary to increase the organic division from 16,000 to 37,000 to support even a reinforced corps. The additional increase to support an army is less than the proportionate increase in supported strength. The increase to support an army was accomplished by expanding the organic division to over five times its original strength by adding appropriate units to its basic structure, rather than by bringing in five organic logistical divisions which would have given an entirely unbalanced troop list and provided five headquarters in a situation where only one was needed. The major portion of the strength of the expanded division lies in the technical services, with the military police a strong contender. It is emphasized that these comments are very generalized and that another situation might paint an entirely different picture.

Whether the expanded division in a specific assignment be designated as a reinforced logistical division or designated by the name of the communications section or other command which it operates is a minor question which would probably be settled locally on its merits. In order to stay within the concept of our current manuals in the assumed situations, "A" and "B," it would probably be better to set up a command called the advance section and then assign the organic logistical division and all of the expansion units to the advance section.

Utilization

Tables of Organization and Equipment for an organic logistical division and a plan for tailoring it to fit the specific situation would be a tremendous advantage over anything we have ever had before in our Army. It would be a great help to planners and to organizers. But it would be an even greater advantage to have some of these units in being, where they could be tested and developed and

used and dealt with, so that their capabilities and limitations could become known, and so that, in event of hostilities, we would have trained units in our active Army which we could throw into that first critical expeditionary force, or into that first critical major defense of our overseas possessions or our invaded home country. It is, therefore, proposed: (1) that logistical divisions be set up in the mobilization plan; (2) that the service forces in overseas areas be organized along the lines of the logistical divisions, and (3) that at least one logistical division headquarters be created in this country to conduct tests and developments, to participate in maneuvers, and to guide the training of the inactive units in the National Guard or Reserve.

Supposing we had such units in being at the start of hostilities. Let us try to visualize how we might use them. If one of the overseas areas were to be developed into a major theater, it is probable that the headquarters of the local active logistical division would become communications zone headquarters. The troop list build-up for the theater would bring in an organic logistical division for each major communications zone section to be created, phased to fit the operation plan. The theater troop list would also carry the additional service units needed to expand these organic divisions. The theater bulk allotment for personnel would carry the personnel necessary to create any non-Tables-of-Organization units or to expand T/O&E units as might be authorized by Tables of Distribution.

Each logistical division commander would move and administer his organic division as a unit, together with such troops as might be attached; thereby making it unnecessary for higher headquarters to have to keep track of the myriad of small units of which it is composed. The logistical division staff would have studied and analyzed the situation and made recommendations on the required organizations, equipment, and plans, thereby relieving higher echelons of these details and insuring coordination between the planners and those who must execute the plans. Headquarters and organic troops would be trained in a common standing operating procedure, and new units would find similar organic units from whom they could learn the ropes quickly. Last, but not least, we would have that smooth running teamwork which is possible only when G-4, G-1, the engineer, and the quartermaster and the rest of the staff have worked and trained together, and all of them are sure that the umpteenth truck company in the logistical division is the best truck company in the Army because they have seen it perform, and besides it belongs to their division. Even greater and more important teamwork will result if the logistical division has trained or served with the ground and air command it will support in campaign. The importance of such training and service cannot be over-stressed.

Perhaps we will go a step further than using the logistical division in the communications zone only. Perhaps the commander who is swiftly putting together an army, an amphibious expedition, or a large airborne task force would prefer to use a coordinated and trained service team, just as he would prefer to use coordinated and trained combat divisions. The logistical division fits easily into the role. Some problems must be worked out on the respective roles of the army and logistical division staffs, and in the composition of the organic troop list, but these do not appear to be insurmountable. If such a solution were generally adopted, organic logistical divisions would be trained for use either in the combat zone or communications zone and used interchangeably with very beneficial results in efficiency, understanding, and mutual confidence among all concerned.

We hear a great deal these days about the warfare of the future, and the lightning blows which will paralyze huge areas without notice, and will render local authorities helpless. The immediate need will then be for police, supply, evacuation, hospitalization, utilities, repair, construction, and the coordinated management and direction of such activities. These are the tasks for which the logistical division is organized, trained and equipped. Combat divisions and corps only partially meet the demand, and in any event should be kept free to repulse the anticipated enemy striking force.

Disadvantages and difficulties with the logistical division concept can be foreseen. In the first place, service troops are generally in such demand that maybe you couldn't always afford to hold them in the Zone of Interior awaiting use as a large unit. That is, it might be necessary, in some cases, to detach badly needed units, or to stage a logistical division in a theater over a long period of time, but the number of times the division would be used as planned, particularly in the critical early stages, would more than compensate. In any case, the headquarters and troops are of greater value because of their prior training. Second, the logistical division might carry units not actually needed. The answer to this is that further training, development and study should give a nearly fool-proof list. In any event, initial troop lists would be much better balanced than anything we now have to start with, in that they would be quite satisfactory as a starting off point. Again it might be argued that the advance of the line of contact, the "leap-frogging" of units and the leaving behind of caretakers and "base-roller-uppers" would soon destroy the integrity of the division. The Logistical Division in direct support of the forces in combat should stay with them. The ones in rear may get mauled in successive reorganizations, but if they accomplish their mission in these critical stages they are amply justified. Time changes all things.

The essence of modern war is speed in repulsing and in striking swift devastating blows. This makes the logistical load greater than ever before. For example, in addition to the field forces, whole sectors of the civilian population may have to be supported after an atomic attack, and our ability to continue the fight will depend on how well we meet that demand. Greater fire power and more technical weapons require more and better service support. Swift, far-flung striking forces require a trained logistical team if they are to succeed. These logistical loads can be handled, in the time available in a future war, only if we approach the period of hostilities with our larger logistical teams trained and ready.

To sum up—the advantages far outweigh the disadvantages. The adoption of the logistical division in our peacetime army, and in the mobilization plan, will give body and substance to our logistical planning and provide a trained, flexible unit for early use at a time of national disaster when every minute counts.

It is particularly important in times of peace that staff planners should be trained in joint logistic planning and that integrated war plans for all possible emergencies should be provided to put our full striking force into action with the speed which total warfare demands. This cannot be done unless the most effective use is made of the means at our disposal.

General Brehon Somervell

The Army Information Program

Lieutenant Colonel J. H. Minton, *Infantry*
Instructor, Command and Staff College

IF our founding fathers had adopted German as our national language instead of English, the title of "The Army Information Program" could conceivably have been translated into something like the following: "The program to supply the Congress, the general public and the personnel of the Army, with the factual information they need in order to understand, to appreciate, and to wholeheartedly support the army in the execution of its missions.

Such a system of descriptive titles, might have some merit in that it would help the average person to have a fair understanding of the program. Even such a title, however, would fall far short of furnishing a complete picture of the mission of the Army Information Program. It would not indicate the reason why this program is of such tremendous importance to the army and to the entire nation both today and tomorrow. To realize the importance of this program, one must consider certain aspects of the general history of warfare.

In the earliest prehistoric time, the strongest caveman who could strike the hardest blow with the heaviest club while uttering the most terrifying sounds was usually victorious. Combat in those days was decided almost solely by the direct application of physical force on the human body.

In World War I the application of "physical force upon the human body" was coupled with the application of "mental stress upon the human mind" so effectively, that though the physical strength of the German Nation was still tremendous, the will to fight had been so impaired by November 1918, that the German people were ready to surrender. The London Times in 1918 estimated that "good (allied) propaganda had saved a year of war and probably a million lives."

Hitler, at Landsberg in 1924, wrote of allied propaganda: "To what terrific consequences a rightly directed propaganda may lead, could be observed for the first time during the war, though unfortunately it had to be studied on the other side. What we failed to do, the enemy did with unheard of skill and a calculation that seems truly the work of genius. The war propaganda of the English and Americans was psychologically correct. In the beginning it sounded crazy and impudent; later it was no more than unpleasant; and finally it was believed. After four and one half years a revolution broke out in Germany, whose slogans came from the enemy's war propaganda."

That the Nazis had indeed learned that wars could be won by applying the right combination of "mental stress" and "physical force" was amply proved by subsequent world events. Few people in the world however, realized how tremendously effective the skillful application of

"mental stress on the human mind" could be in the winning of wars, even after the Germans marched triumphantly into Austria and Czechoslovakia, without firing a shot. These two conquests had been accomplished without the actual use of "physical force." True, the threat of the use of physical force had been present and the force itself had been possessed by the victor, but so skillfully had mental stresses been produced in the minds of all concerned, that the will to resist the Nazis had been largely eliminated from the minds of the Austrians and the Czechoslovakians.

Hitler, who had now proved that he and his partner Goebbels were experts in the use of propaganda as a weapon of war, had written in his book *Mein Kampf* the following rule for its use: "It must always and exclusively be directed towards the masses. The teachability of the great masses is very limited, their understanding small and their memory short." Our own phychologists agree that lowered morale of troops or civilians may result, in large part, from fear and uncertainty caused by ignorance of what is going on. Exploitation of ignorance is a basic rule in the employment of propaganda. In *Psychology for the Fighting Man* prepared as a contribution to the war effort, the following statement is found; "But any soldier may himself be the subject of propaganda. His best defense is to know about propaganda, about what is going on, about how the total war is being won. American soldiers want to know why about such things."

The Army Information Program assumes the task of furnishing timely factual information, so that both the American soldier and the American people will be the best informed in the world and, therefore, the least likely to be influenced by the mental stress that any enemy may attempt to create in them.

In case there is any doubt concerning the propriety of supplying information to the public, let us remember that if there are future wars, all of us will be in "the front lines" because such wars will surely be "total wars" and all geographical localities in the nation will lie in the combat zone. The farmer and the war worker will be more vulnerable to the enemy's physical and mental attack than ever before.

Because there may be a few readers who are members of the now almost extinct school who believe that it is wrong to tell anyone anything about the military establishment, let us go back for a moment to General George Washington's day and consider what the then Inspector General of the Continental Army thought. General Von Steuben wrote in 1778, "The genius of this people is that one must first explain—and then give the order."

So important to the War Department is this matter of disseminating information, that the Chief of Public Information reports directly to the Chief of Staff. As policy maker, he controls the activities of three of the ten divisions of the War Department Special Staff. These three are; the Public Relations Division, which supplies information to the public; the Legislative and Liaison Division, charged with supplying information to the legislative branches of the Government, and the Information and Education Division whose mission it is to make the American soldier the best informed in the world. As the Legislative and Liaison Division functions almost entirely on the War Department level we need have little more than academic interest in its operations. This division came into being as it became apparent that, if legislators were going to deal wisely with military matters, they would have to be furnished accurate information regarding the military establishment whenever they needed it.

The Chief of the Public Relations Di-

vision is charged with planning, preparing and disseminating information of the War Department and its activities and of the army as a whole to the American people. To accomplish this mission of portraying and interpreting the American Army to the American people with minimum personnel and maximum efficiency, public relations functions are decentralized to a great extent. Policy control is maintained by the War Department, but contact with the public is encouraged at all levels of command throughout the army.

The Chief, Information and Education Division is responsible for obtaining, preparing and furnishing information that will make the personnel of the army the best informed on a wide, yet pertinent range of subjects. To this end there have been and are being developed, timely programs of interest and value to all army personnel. The commander of troops who takes full advantage of the information and educational materials thus made available will find a satisfactory solution to some of his more pressing morale and personnel problems.

Because education and information are at times so nearly synonomous, it is only natural that the United States Armed Forces Institute (USAFI), located at Madison, Wisconsin, should be administered in part by the Information and Education Division. USAFI is a joint Army-Navy project that also serves the Marine Corps and the Coast Guard, provides all armed forces personnel the opportunity to continue their non-military education while in the service.

The Army Information School at Carlisle Barracks, Carlisle, Pa., is also under the supervisory control of the Chief of Public Information of the War Department. This school has been established to provide training in both phases of army information; information to the public, and information to troops. Here specially selected officers are trained as public relations officers and information and education officers, and selected enlisted men are trained to serve as assistants.

At Headquarters, Army Ground Forces, there is an information section, combining, under one chief, the functions of public relations and information and education. This organization furnishes information to the public and to the army on the Army Ground Force level.

Each of the six army headquarters in the Zone of the Interior today, has an information section responsible for the functioning of the public relations and information and education programs within its area. Certain functions, including the review of material submitted for publication which pertain to its area only, and for which a policy has been established, are now delegated to these headquarters. Material which concerns more than one army, the army as a whole, or the War Department must be cleared by the War Department Public Relations Division.

Each post, camp or station is authorized a public relations officer who usually reports directly to the post executive and who coordinates the flow of information to the public for all units at his post. An information-education officer is authorized for each post, camp or station, but unfortunately he is sometimes so burdened with additional duties that it is impossible for him to do justice to this important one. When this happens, all of the planning and work that has been done at higher levels is of no value, because the program does not reach the very personnel for whom it was intended. The tables of organization of corps and divisions have been changed to include both public relations officers and information and education officers as permanent staff members.

One of the considerations of greatest importance in furnishing information to

the public is that of timeliness. The public will demand that it be informed on specific subjects when it is interested in those subjects. If the correct information is not forthcoming promptly, the public, or at least some portion of the public, is very apt to believe anything that is at all plausible, and generally is willing to believe the worst. Well trained and skillful personnel are needed to anticipate public interest correctly, and obtain in advance the information that the public will probably demand.

The speed with which the tremendous task of redeployment and demobilization was accomplished, greatly increased the difficulty under which information personnel labored. Because almost everyone was completely engrossed in the task of getting as many men home and demobilized in as short a time as possible, there was little attempt made to explain to anyone that we were running way ahead of even the most optimistic expectations. Here again, the timely release of information regarding actual accomplishments would probably have done much to reduce the volume of undeserved criticism of the army. Citing cases such as that of the 654th Tank Destroyer Battalion whose personnel, all high pointers, were told in July 1945 that they could not expect to leave Germany before February 1946, but all of whom arrived in New York on 29 September 1945, would have proved that performance was exceeding promises.

By contrast, the timing and manner of releasing information, regarding the integration of more than 9,000 recently appointed Regular Army Officers, was such that, as far as is known, not one word of unfavorable comment has been heard. Important, of course, was the fact that care had been taken to set up the fairest system of selection that could be devised. In order to carry the announcement of the appointments to the public in the most acceptable manner, arrangements were made for the Army Commander in each area to congratulate a small group of newly appointed officers as representative of those appointed from that area. Pictures were taken, with at least one appointee in each group in civilian clothes to emphasize that officers who were no longer on active duty were not being discriminated against. As it was feared that the naming of the successful applicants would be followed by a wave of requests for separation from those who were unsuccessful, which was definitely undesirable, timely information was released regarding the fact that a request had been made for authority to appoint 25,000 addition officers, most of whom would be appointed from the present lists.

Another illustration of good timing and planning, is found in the successful release of information concerning the Armed Forces Leave Act. Faced with the terrific task of preparing the necessary forms, bonds, etc., and setting up the machinery to handle millions of applications, the finance officers of the armed forces were appalled at the probability that hundreds of thousands of requests for information would pour in upon them, further complicating the problem. First it was decided to adopt identical procedures for all branches of the service. Then the problem of notifying the veterans was turned over to the Public Relations Division and the finance people went to work on their own job.

The public relations solution was as simple as it was effective. Appropriately worded news releases, spot radio announcements and brief skits clearly telling the story were prepared. The commercial radio networks, who are always more than willing to cooperate in any matter of national interest, gave radio time to military speakers and inserted spot announcements between their regular programs. In a few days, practically all interested veterans and service personnel had been

informed and were satisfied to wait until application forms were available.

In conclusion, the Army Information Program is designed to furnish to our legislature, our public and the personnel of our army, full, timely and factual information concerning the army, its mission, its problems and its needs. If all of us in the army remember that the army is at all times the servant of the people—not a dumb, stupid, plodding servant—but an intelligent, loyal, willing servant, that knows its mission, needs and problems, and is always willing to tell the boss what it is doing, then the army will always have the support of the public and the strength to perform its mission.

In addition, to the extent that all of us participate in, utilize, study and live by the principles of the Army Information Program, so will the people, the legislature and the personnel of the army, enjoying mutual confidence each in the other, become so increasingly well informed on all pertinent matters that no enemy will ever be able to engage successfully in any campaign of physical or mental force upon the bodies or minds of the people of the United States.

More than most professions the military is forced to depend upon intelligent interpretation of the past for signposts charting the future. Devoid of opportunity, in peace, for self-instruction through actual practice of his profession, the soldier makes maximum use of historical record in assuring the readiness of himself and his command to function efficiently in emergency. The facts derived from historical analysis he applies to conditions of the present and the proximate future, thus developing a synthesis of appropriate method, organization, and doctrine. . . .

Soldiers of an Army invariably reflect the attitude of their general. The leader is the essence. Isolated cases of rapine may well be exceptional but wide spread and continuing abuse can only be a fixed responsibility of highest field authority. Resultant liability is commensurate with resultant crime. To hold otherwise would be to prevaricate the fundamental nature of the command function. This imposes no new hazard on a commander, no new limitation of his power. He has always, and properly been subject to due process of law. Powerful as he may become in time of war, he still is not autocratic or absolute, he still remains responsible before the Bar of Universal Justice. From time immemorial the record of high commanders, of whatever side, has been generally temperate and just. The lapses during the latest war are contrary to past trend.

General of the Army Douglas MacArthur

The G-2 After-Action Report

Lieutenant Colonel W. E. Eckles, *Cavalry*
Instructor, Command and Staff College

Introduction

SINCE there are no prescribed forms which might be used in the preparation of after-action reports, an examination of many reports submitted by units during the last war indicates the existence of a wide diversity of opinion on the part of commanders concerning the information which should be included, and the choice of an appropriate form to be followed in the rendering of such reports. As a result of this variance, some after-action reports have proved to be of little worth, and in many instances, valuable historical records of actions against the enemy have been left incomplete.

The purpose of this article is to reflect upon the importance of, and the necessity for, after-action reports; and, to present a form which might be used as a guide or check list in the preparation of the intelligence portion of the after-action report of a division or higher headquarters.

Necessity and Importance

Among the important factors to be considered in the preparation of an after-action report are the following:

(1) To make an accurate, complete recording of the essential events which occurred during the period covered by the report.

(2) To give thoughtful consideration to the quality of the subject matter with regard to its clarity, conciseness, and form.

(3) To include a full accounting of the lessons learned, and, if appropriate, to make recommendations for corrections to afford a basis for the improvement of techniques and future training.

Paragraph 10, Army Regulations 345-105 directs that: "After every battle or engagement with the enemy, or when prescribed by higher authority, written reports thereof will be made by commanders of regiments, separate battalions or squadrons, companies or detachments, and by all commanders of a higher grade, each in what concerns his own command. Such reports will have annexed thereto the unit and staff journals, together with their supporting documents, which reports will be forwarded through the proper channels, as early as practicable, to The Adjutant General, except. . . . It will be the especial duty of all general staff officers attached to commands in the field to keep careful journals of the operations, from which they will compile reports of said operations for their immediate commanders. Commanding officers may require preparation of reports described above during maneuvers or other exercises for training purposes, . . ."

Therefore, after-action reports may be required by higher headquarters during, or upon the completion of field maneuvers or other training exercises, and they will always be submitted by units in combat, as prescribed by Army Regulations. In either case, it is of utmost importance

that all officers become aware of their responsibilities in preserving information which provides a historical record of the operations, an account of noteworthy lessons learned, and recommendations for improving techniques and future training.

A Form for the G-2 After-Action Report

In an attempt to produce a suitable form or check list for use as a guide in the preparation of the G-2 after-action report, an analytical study was conducted of after-action reports submitted by many units during the last war. Based upon these reports and other data available at this time, the following form was developed and is presented as a practical solution. However, since the form has purposely been made as comprehensive as possible, it is apparent that some portions will not be applicable in all situations and should therefore be omitted. In all cases where appropriate, each subparagraph used for reporting should include both the favorable and the unfavorable comments.

INTELLIGENCE SECTION

I. Enemy Situation and Operations:
- A. Organization for Combat:
  1. Order of battle.
  2. Defensive works.
  3. Logistical organization.
- B. Operations (Narrative).
- C. New Developments:
  1. Organization.
  2. Tactics.
  3. Weapons.
  4. Matériel.
- D. Enemy Intelligence and Counterintelligence Organization and Activities.
- E. Estimated Enemy Losses in Personnel and Matériel.

II. Own Intelligence and Counterintelligence Organization and Operation:
- A. Organization of Unit Intelligence Sections and Agencies.
- B. Operation of Unit Intelligence Sections and Agencies.
- C. Intelligence Staff Planning and Coordination.

III. Lessons Learned.

IV. Recommendations:
- A. Intelligence and Counterintelligence Plans.
- B. Air-Ground Intelligence Coordination.
- C. Estimates of the Enemy Situation.
- D. Intelligence Annexes to Operations Orders.
- E. Journal and Supporting Documents:
  1. Message file.
  2. Intelligence summaries.
  3. G-2 Periodic reports.
  4. Maps, overlays, aerial photographs, and sketches.
- F. Terrain Studies.
- G. Changes in Intelligence Organization and Functioning, to Include Intelligence SOP.
- H. Order of Battle Reports.
- I. Interrogation Prisoner of War Reports.
- J. Photo Interpretation Report.
- K. Military Intelligence Interpretation Report.
- L. Air-Ground Operations Section Report.
- M. Technical Intelligence Report.
- N. Psychological Warfare Report and Others.

Conclusion

It will be noted that the form is adaptable to any type of unit in any kind of operation, and may be modified to fit any particular situation. Its use during the early phase of World War II would have facilitated greatly the application of sound principles to training activities, and the development and standardization of new techniques. Its improvement will be contingent upon the constructive comments and suggestions of interested commanders, staff officers, and others.

Chemical Weapons
Of the Future

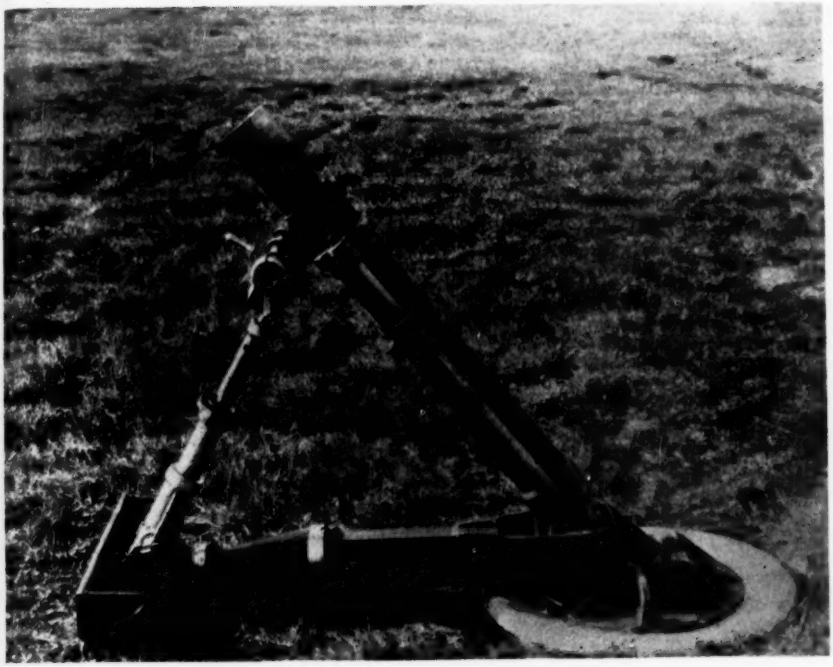
Colonel M. E. Barker, *Chemical Corps*
Commandant, Chemical Corps School

THE best way of predicting future developments is to plot the history of their past and project this historical curve into the future, modifying its direction and rate of progression by those factors which modern science indicates as being applicable to that particular problem. This method will be used in peering into the future briefly to see what chemical weapons may be available to help win the next war, or possibly to prevent future wars.

Mortars

Since mortars are the mankillers of modern battlefields, and heavy mortars are the most effective for this work, we will start with the 4.2-inch chemical mortar. At the end of World War I this smooth bore weapon could fire twenty big shells per minute to a distance of eleven hundred yards. It was the best heavy mortar in the world, in spite of the tumbling shell, inaccuracy, and the short range. By 1930 the barrel of this mortar had been rifled and the base of the shell provided with an expanding disc so that the shell was given true flight, while the muzzle loading rapid fire features were retained. This improvement increased the range to twenty-four hundred yards and improved the accuracy without changing the weight of the shell, the filling, the mortar itself, or the propelling charge. That was a real advance, because the mortar could still be fired twenty times per minute for two or three minute bursts.

Improvements in propellants and methods of ignition during 1940-41 stepped up the range, first to thirty-two hundred yards, then to an official maximum range of forty-four hundred yards, though the weapon was fired many times at ranges exceeding five thousand yards in battle. An increase in the length of the barrel and a change in the manner of starting the rifling in the barrel, and a few other small improvements, added another thousand yards to the range on the proving ground; but this development did not get into production. The factories were too busy turning out millions of shells, thousands of standard mortars, and quantities of spare parts to feed the hungry appetites of twenty-four mortar battalions firing all the way from Italy to Burma. Now that we have had time to put together some of the tricks learned by the Germans, the Japs, the Russians, and our own researchers, we find that we can build a mortar that will give extreme accuracy at five thousand yards range, and good area accuracy at seven thousand yards or more. That is enough. Artillery and long range rockets can handle the battlefield from there backward more effectively than can mortars. We must learn where each weapon can do its most effective work and keep it on that job. A sixfold increase in range in a few short years is no mean accomplishment for any weapon. This new long range, coupled with a greatly improved baseplate and a 1600 mil traverse, will allow the chemical mortar battalion of the future to lay down 720 shells per minute on a designated target. With choice of high explosive,



Proving ground version of the new 4.2-inch chemical mortar. (Dugway Proving Ground photo.)

smoke, incendiary, flare light, or gas filling this weight of fire can be concentrated with devastating effect upon any target within many square miles of area. Since each shell carries twice the weight of explosive of a 105-mm howitzer shell, it is easy to see how effective these concentrations will be.

Incendiary Weapons

During World War II man's oldest weapon—fire—was harnessed anew as his most effective weapon. Even the atomic bomb did not equal the destructiveness of a single massed incendiary air attack in either the number of persons killed or the amount of enemy property destroyed. One atomic bomb was far more expensive than the whole lot of incendiaries.

Incendiary air bombs of two main varieties (and in size from two pounds to 500 pounds) were perfected and nearly a billion of them made during World War II by the Chemical Corps.

First, there was the German electron type bomb, of small size in which a tube of magnesium metal was filled with thermit mixture which, upon being ignited, first melted the magnesium, then set it on fire so that the entire bomb burned. This was an intensive type incendiary that reached a high state of development, but in the future we may expect certain metals to be added to the magnesium which will

make a hotter fire and will produce an extremely nauseating smoke from the burning metal. Then, too, there are many mechanical and chemical improvements already known which, taken together, will double the effectiveness of this type of bomb.

The second, or scatter type of incendiary bomb, is the American tin can filled with jelled gasoline. This mixture was ignited in various ways which can be improved. The burning chunks of sticky gasoline were thrown around to considerable distances upon impact or delayed functioning. There were two varieties of these bombs —one which exploded and threw out many chunks of blazing gasoline in all directions, while the other shot all of its charge out of the bomb in one chunk just as if the bomb were a mortar. Now gasoline has a very high BTU, or heating value per unit of weight, but its density is only about three-fourths that of water. What we need, and will get, is a filling at least twice as dense and more sticky than gasoline which will burn more fiercely and will have a higher heat content per unit of volume than does gasoline. We will get it if we have to jell mustard gas and use this as an incendiary filling. That is easy to do, and mustard gas burns with a blue, hot flame. However, there are better incendiary fillings to be had than mustard gas, so we may expect future incendiary bombs to be at least three times as effective as those used in World War II.

A flame thrower operator, covered by supporting fire, burns out a Japanese pillbox, Saipan, 17 June 1944. (Signal Corps photo.)

Then we will all have to take to the cave, because these new and more effective incendiaries can be used on small, tactical targets, and the atom bomb, or radioactive toxic gases, can be reserved for extremely valuable, congested, strategic targets.

Whether the cave is the ultimate defensive answer or not is open to question, at least on the tactical battleground. Men in dugouts are ideal targets for flame throwers, which can kill without singeing a thread of the victim's clothes by simply using up all the oxygen in the air of the cave, and at the same time creating a very high concentration of carbon monoxide in the enclosure. The victim ceases to be a soldier quickly and painlessly.

Portable flame throwers came out of World War I as a completely discredited weapon. As Director of Research in the Chemical Warfare Service much of the time between the two world wars, I was forbidden to spend a nickel of government money on flame thrower development until 1940. But fire in quantity is a terrible weapon, and this one was not to be denied. By making a few pertinent refinements on the old German portable flame thrower, and using jelled gasoline for fuel, the effective range was made three times greater. It was the only weapon available that would "shoot 'round the corner." It was therefore highly effective against the Japs who buried themselves in caves. In the tank mounted model it was still more effective. The one American armored flame throwing battalion did yeoman service at Okinawa, as did the marine units on islands in the Pacific and the British battalions in Europe. Unfortunately both the portable and the tank mounted flame throwers are terribly inefficient because so much of the fuel burns in the air between the weapon and the target, even when the fuel is jelled. What we need, and will get, are flame throwers that hurl capsules of fuel accurately and at considerable range so that the capsules burst on and in the target and all the fuel burns there. There are several ways of doing this, and it will be done within ten years in spite of all the folk who wring their hands and say, "Impossible." Get a heavier fuel that jells well, and do it up in capsules, and you will get a portable flame thrower that produces a far greater effect on a target two hundred yards away than has been possible heretofore at ranges of thirty-five to forty yards. The flame thrower has just started to develop in its modern form. In range, it is still behind the fire arrow of the American Indian or the ancient Persian archer. As for the armored flame thrower, all we have to do is to turn the cannon into a flame thrower to get an effective range of half a mile. A legal patent on a good flame thrower fuel capsule, would be worth at least a million dollars!

Smoke

In 1939 we set out on a research project to produce a synthetic London fog. This was done in the laboratory after two years of work; then came the problem of devising a machine to do it in the field on a large scale. An idea was conceived, and a monstrosity of a machine was turned out that made a thin trickle of smoke that *was* a London fog. Having shown that a durable smoke could be machine made by condensing a thin film of oil about a droplet of water the problems of design were not too difficult, and soon there were half a dozen efficient machines that made mechanical smoke. One of these was selected and developed into the big Esso (M1) model. Then a baby model known as the foxhole generator (M2) got a big play, and the Navy split the difference for a middlesize mechanical smoke generator known as the Besler model. These three models produced billions of cubic feet of oil-and-water smoke that covered exposed roads and anchorages

from North Africa and Italy to the Pacific. Smoke came to be generated by the square mile, where before the war the unit of measure had been the artillery square, 100 yards on a side. A new chemical unit, the smoke generator company, was formed to use this new weapon. At Okinawa, smoke helped save many ships from Jap suicide pilots, because these

The Besler Mechanical Smoke Generator (Navy type) in action on Anzio Beachhead. This middlesize generator is best one for future development. (Signal Corps photo.)

fellows could not slam a plane into a ship they could not see any more than the bombardiers could hit a target at which they could not aim. Then came radar, and clouds and smoke were of mighty little effect against area bombing. Even mortars and land artillery as well as naval guns were being laid and directed by radar. It looked as though smoke was on the way out. But the wheel of fortune spins, and no man can tell what may happen ultimately; however, for the immediate future it looks like a toss-up between a combination of smoke and "window" against radar; with a smoke eventually to be produced that will bounce a radar beam like a duck's back turning a thin stream of water. That means that smoke is going to be mighty effective in the future even against guided missiles, as well as against gun laying and bombing radars. You can't go to sleep in this scientific race or you will find your long range missiles being returned to base instead of proceeding to the expected target.

Gas

There have been lots of guesses as to why toxic gas was not used in World War II. There were times when its use would have won battles and even campaigns: Corregidor and Bataan, for example. They were ideal gas targets. At Anzio, gas in sufficient quantity would have been the end of the beachhead. Gas on Berlin would have been far more effective than explosives or incendiaries. For example, half a dozen bombers per week loaded with paper bags filled with solid crystals of tear gas could have dumped enough gas on Berlin to have driven the population to the country and kept them there for long periods. Tear gas would not have killed anybody, but after hours and days, the gas mask would have become unbearable, and simple tear gas could have depopulated Berlin. Large air attacks with phosgene in cold weather and mustard gas in hot weather would have created passive air defense problems of unsolvable magnitude. Once we had Okinawa as a base, and command of the sea and air, we could have depopulated Japanese cities with a hundred and fifty thousand tons of gas bombs. Frankly no combatant was in a position to use gas without a well founded fear of retaliation against his own population until just before VJ-day—then it was not necessary.

But gas in the future? If it is to the

military advantage of one side or the other, it might well be used. Certainly all will have to be prepared to defend against it, and that is going to be some job when arsenic, phosphorus, and sulfur can be made highly radioactive and so impart this property to war gases in addition to the usual toxic qualities. This new gas certainly will be more than enough to worry the field commanders, the chemical staff officers, and the soldiers. Radioactive toxic gas may be even more effective against strategic targets than atomic bombs.

Other Agents

This brief discussion of the evolution of some of the major chemical weapons and munitions should give the reader the idea that a number of the weapons are "going to town." The Chemical Warfare Service has now become the Chemical Corps by Congressional action. Its research scientists, its troops, its manufacturing plants, its training facilities, all have major problems on their hands in keeping up with kaleidoscopic changes that are taking place in physics, biology, chemistry, and engineering, and applying these new developments to the problems of offense and defense in the field of military technique. The problem would be tough enough if there were no new weapons in sight.

That certainly is not the case, for there are a number of new weapons of major importance to all branches of the military service. For instance, there are guided long range missiles, drone airplanes, and medium long range high capacity rockets that may become extremely important for tactical operations and as carriers of chemical fillings of various types, especially when used with toxic gases having the extra effect of being made in part of radioactive elements. There is some possibility of using sound waves of the right length and frequency to dissipate limited areas of Aleutian fog; as well as to break down the nervous system of men and animals at a distance from the source. Of course, this will involve two different sets of gadgets.

Every great war produces a variety of new mechanical developments and chemical inventions that ultimately prove of great value to mankind, though they were not developed for that purpose. The last war produced such a bewildering variety of new things that it will take fifty years of intensive effort to perfect the right ones for war purposes and to adapt the useful ones to daily commercial life. Already we have selective weed killers and flame thrower cultivators which promise to revolutionize agriculture and gardening. It looks as if the Chemical Corps has plenty of work ahead in its field, since this Corps serves the Navy and the Air Forces, in addition to the Ground Forces.

The amount of ammunition and explosives sent overseas was tremendous. During the forty-five war months, approximately 9,500,000 short tons were shipped to the United States forces, and about 2,000,000 tons to our allies, making a total of about 11,500,000 tons. The highest monthly shipment was 685,000 tons in December 1944, when the invasion of Germany was requiring extraordinary expenditures of ammunition to blast out the enemy and reduce our own casualties. Practically all of this cargo, including that for our allies, was shipped over terminals operated by the Transporation Corps.

Report of the Chief of Transportation.

Joint Operation Aspects of the Okinawa Campaign

Lieutenant Colonel Walter Killilae, *General Staff Corps*

This is the first in a series of three articles on this subject by Colonel Killilae. The second and third articles will appear in subsequent issues of the MILITARY REVIEW.—The Editor.

Introduction

OKINAWA, which is about sixty-five miles long and averages about five miles in width, is roughly divided into almost equal northern and southern parts by the Ishikawa Isthmus. The northern area is generally rugged, mountainous, wooded, undeveloped, and of little military value. The southern area, which is generally rolling, but frequently broken by deep gullies and ravines, is the developed part of the island and contains a major portion of the island's 400,000 population. As anticipated the strongest defenses of the island were in the southern area.

From many standpoints the Okinawa operation was one of the most difficult ever undertaken by our forces in the Pacific. It was defended by about 120,000 men (including natives serving with the combat forces) with some tanks and the heaviest concentration of artillery ever encountered in the Pacific. Possible reinforcements in the Nansei-Shoto chain were estimated as some 60,000. Larger forces were available on Formosa, Kyushu, and in the Shanghai area. The most serious threat, however, was its closeness to the Japanese homeland, easily within air striking distance. Severe damage and losses, therefore, had to be expected and accepted as the price of success.

The Joint Chiefs of Staff issued the directive for "Operation Iceberg," as the Okinawa Campaign was known, to CINC POA (Commander in Chief, Pacific Ocean Area) late in September 1944. In turn, late in October 1944, CINC POA issued a directive, for planning purposes, to all units to be involved in the operation, with a target date (L-day) of 1 March 1945. This date, however, was later changed to 1 April. The overall command of the operation was assigned to the Fifth Fleet. The Joint Expeditionary Force commander was to be in command during the assault phase of the operation and to remain so until such time as our forces were declared secure on the island. The Navy retained control until 17 May 1945, when command of all forces passed to the Commanding General, Tenth Army.

In the planning phase of the Okinawa Campaign, three assumptions were made which later proved to be fully justified. It was assumed: (1) that the Iwo Jima Operation would be completed at a sufficiently early date to permit availability of fire support units and close air support units for the assault on Okinawa; (2) the results of operations against Japan proper, Formosa, the Ryukyus, and the enemy fleet during the period preceding the target date indicated that we would be able to maintain constant con-

trol of the air in the target area and; (3) that ground elements, assault shipping and supporting naval forces would be released promptly from the Philippine operations.

The object of the Okinawa Campaign was: (1) to establish bases from which to attack the main islands of Japan and their sea approaches, support further operations in the regions bordering on the sea coast of China, and sever Japanese sea and air communications between the Empire and the rest of her occupied territory; (2) to establish secure sea and air communications for ourselves through the East China Sea to the coast of China, and; (3) to maintain unremitting military pressure against Japan.

Navy Phase

Joint Expeditionary Forces, or Task Force 51, had five subordinate task forces. Their titles and task force numbers were:

TF 52 Amphibious Support Force,
TF 53 Northern Attack Force,
TF 54 Gunfire and Covering Force,
TF 55 Southern Attack Force,
TF 56 Expeditionary Troops.

Task Force 51 was given multiple missions as follows:

1. Capture, occupy and defend Okinawa.
2. Destroy or drive off enemy forces attempting to interfere with the movement to, or the landing operations at, the objective.
3. Direct the operations of aircraft of the Joint Expeditionary Force and those which may be designated from other forces for the air support of landings.
4. Direct mine-sweeping operations.
5. Initiate base development and the establishment of military government.
6. Prepare to complete the occupation of Okinawa and to capture and occupy Ie Shima as a continuation of this operation.

The British furnished a carrier force to take part in this operation. This Task Force (No. 57), under Fifth Fleet, was directed to maintain, after L—10 and until further orders, the neutralization of airfields in the Sakishima group of islands, nearly mid-way between Okinawa and Formosa. This task force was to provide its own logistic support and plan of operations subject to approval of Commander, Fifth Fleet.

The U.S. Carrier Force, Task Force 58, also directly under Fifth Fleet, participated in the operation, and will be discussed in the section under air support.

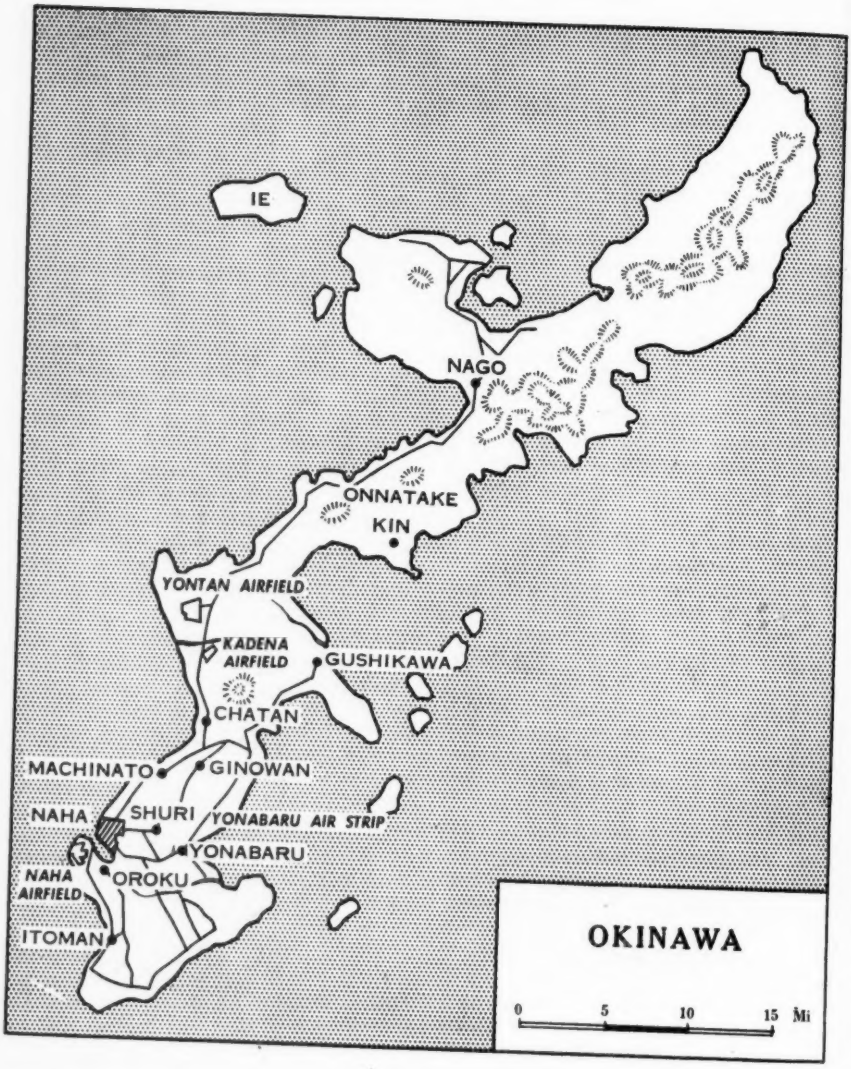
The Commander, Forward Area, Central Pacific, Task Force 94 (a command perhaps comparable to the commander of the intermediate section of a large army communications zone) was given naval escort, and the authority to call on other naval forces for air support.

An unofficial aggregate of forces involved in this operation included over 1,600 surface vessels, forty-three groups of aircraft, and 500,000 personnel, of which 350,000 were navy.

The first mission for the Joint Expeditionary Force, and the mission with which we are primarily interested, was as follows: "This force will capture, occupy and defend positions in the Okinawa Islands beginning L-day minus 6, and initiate the development of advanced naval bases and air bases on the captured islands in order to establish control of the sea and air in the Nansei-Shoto area." (Note—The term Nansei-Shoto includes the entire chain of islands, of which Okinawa is the heart, between Formosa and Japan.)

The accomplishment of this mission was planned in three phases covering a period from L—6 (26 March 1945) to an estimated L+120 (29 July 1945).

Planning and preparation progressed concurrently with operations then being conducted. Strategic and tactical air support, naval gunfire support, movement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schedules, assembly of troops and supplies were carried out with a seeming minimum of changes. In the months from October 1944 to March 1945 the advances of the American forces by the campaigns of Leyte and Luzon, the reoccupation of the Philippines, the smashing of the main Jap fleet in late October and the capture of Iwo Jima had made possible the establishment of advance naval and air bases, and had given increased control of sea and air. In the words of General Marshall, "It was now possible to drive forward into the Ryukyus along the main Japanese archipelago bordering the East China Sea."

In reviewing the actual operations, there are a few items that appear necessary to highlight the naval action.

The protection of the hundreds of naval vessels to be engaged in the operation made necessary the innovation of an around-the-islands "radar picket" system. This system placed a minimum of nine stations around the islands in designated operating areas. The radar picket circle was established to provide early warning of the approach of enemy aircraft, particularly low-flying planes, and also to facilitate interception at as great a distance as possible from the transport area. The pickets carried fighter-director equipment as well as the scanning apparatus.

These radar pickets absorbed the brunt of 560 raids from over 2,200 planes during the period from 26 March to 17 May. Of the original nineteen ships on which fighter-director equipment was installed, five were sunk, eight were seriously damaged and three others received minor damage.

Plans for the operation had considered the use of floating radar pickets only until outlying islands could be secured and the necessary installations made. However, the heavy casualties suffered by the radar pickets called for an unexpectedly large replacement of personnel and equipment. Operations were juggled to permit earlier than planned seizure of five of the necessary outlying islands. As a result of these developments, there were times in the early stages when the picket system was not fully effective.

In the Okinawa operation, the Navy had only one surface engagement other than with the hundreds of small suicide boats encountered. This surface engagement occurred on 7 April when an enemy task force composed of the battleship *Yamato*, a cruiser and eight destroyers, were intercepted by U.S. Carrier Force planes. All enemy vessels except four destroyers were sunk, and the four destroyers were heavily damaged. This can be considered the final blow to Jap naval prestige.

Underwater demolition team training, organization and supply are a navy responsibility. For the Okinawa operation ten teams were used. Missions assigned and executed varied through preliminary beach reconnaissance beginning L—7. These included diversionary demolitions on selected beaches, removal of obstacles on assault beaches from L—2 to L-day, use as guides on assault control boats on L-day and later assistance in clearing anchorages of underwater debris, blasting channels and trimming reef edges.

The magnitude of the communications requirements for an amphibious operation of this size is enormous. Use of a fleet broadcast controlled by the Commander, Joint Expeditionary Force, better assignment and utilization of frequencies, and improved ship-to-shore circuits, also used for transmitting press releases, were features. In all of the after-action reports noted, it was interesting to find that navy troubles with security and the need for additional communications personnel were emphasized.

The Gunfire and Covering Force, Task Force 54, supported all landings, provided continuous reinforcement to the Ground Forces throughout the operation,

engaged in small boat counter-measures, and insured cover for the whole force in the vicinity of the objective against hostile surface attacks. The coordinated fires of ten battleships, nine cruisers, twenty-three destroyers and 177 gunboats provided pre-H-hour bombardment of beaches on L-day. Beginning L-day, target information centers were maintained by Tenth Army, III Amphibious Corps, and XXIV Corps in close coordination with the respective naval intelligence and gunnery officers. All deep fire support was coordinated by the Tenth Army Artillery Officer. All targets located by air or ground observers, or by means of photographs, were reported to the center responsible for the sector in which they were located, and then assigned to fire support ships, artillery, or air support. Certain "no gunfire lines" and "lanes" were established. Some small troubles in this coordination occurred. Direct fire support ships were initially assigned at two per regiment but later this was changed to one, except in case of special attacks. Over 25,000 tons of naval fire support ammunition had been expended by L+46.

Considering the use of navy fire support positions around the entire island, it is interesting to note that thirty-four ships, continuously assigned to fire support missions during twenty of the first forty-six days, were on firing assignment for an average of nearly sixty-two per cent of the time, day and night.

The naval gunfire plan of the Okinawa operation was better than previous gunfire plans in that it was more flexible, and that gunfire communications were better. For the first time, ships assigned to the Gunfire and Covering Force constituted a permanent organization, ships once assigned remained assigned and were not rotated with the screen or other duties. In addition, the higher level fire support plans had previously designated a specific ship to fire each planned mission. This time the mission was given, and the Commander, Task Force 54, was permitted to designate the ships to fire.

The Joint Expeditionary Force smoke plan provided a plan for covering anchorages with smoke during enemy air attacks at night. During the action, and with the exception of use during underwater demolition team operations, mock landings, the landing at Ie Shima and during minesweeping operations, smoke was used ouly during darkness by the Navy. The deduced reasons for limiting the use of smoke to night time are that the radar directed antiaircraft guns can still fire, the radar equipped night-fighters can still function, and the fire-power of the visually operated antiaircraft guns in daytime more than offset the value of the smoke screen and decrease in daytime visibility. In addition, of course, was the highly efficient operation of our daytime air-fighters.

Fleet logistic problems presented for this operation were enormous. As previously mentioned, over 1,600 ships and over 350,000 naval personnel were involved, plus the transport of the Ground Forces and their supplies. Ports from Seattle to Leyte were involved. The decentralizing of authority and responsibility were expected. CINC POA and other high headquarters provided the top-level coordination and arrangements. Initial logistic requirements for the operation had been made before L—90, and, at about that date, scheduled conferences were started between logistic representatives of the services concerned. For carrying out the plan under Fifth Fleet, the Logistic Support Group, Service Squadron 10, and the Forward Area Force were the operating agencies. Under Joint Expeditionary Force no separate logistic group was established, each headquarters being responsible for its own participation. In general, this administrative setup operated satisfactorily. The problems regarding

ship and plane fuel, ammunition, lubricating oil, food, spare parts, and ship salvage and repair were the major ones. The only unsatisfactory items reported were the delivery of mail and registered publications, plus some transportation difficulties in delivering naval replacement personnel.

The ships' salvage and repair problem was huge due to the damage inflicted by the hundreds of suicide aircraft and small boat attacks. However, many ships were returned to duty by repairs made in combat area bases.

The Okinawa operation was the most thoroughly reported naval action in the history of Pacific warfare. More press and radio correspondents were accredited for this operation than ever before. Several small ships including LCIs were assigned for public relations duty. A highlight of the public relations activities were the radio broadcasts direct from the Okinawa area. Listening audiences were estimated to have been as high as sixty-five million people.

The amphibious operations for the capture of Okinawa, in terms of ships employed, naval gunfire delivered, naval air support conducted, and the magnitude of the logistics problems and distances involved may well be considered the largest in the Pacific Ocean warfare.

Air Support Phase

The planning for the air support of the Okinawa operation embraced three principal responsibilities: First, the preliminary aerial bombardment and reconnaissance of the operational and supporting enemy areas; second, the direct preparation and support of the assault; and third, the maintenance of air superiority, air defense, and continued neutralization of enemy air installations during and immediately following the operation.

Supporting Forces.—The forces and assigned tasks for the air support plan consisted of:

a. The 20th Bomber Command, a B-29 force, operating from the Marianas, with the requirement of directing all available sorties on Formosa, beginning 2 March or L—30. Then they were to strike the air installations on Formosa again, the Pescadores, and Sakishima Gunto, starting on 16 March. This action was to be in ccoperation with the Southwest Pacific Air Force, and was to precede the scheduled carrier strikes on Formosa on 18 March, continuing through 1 April or L-day, until the capture of Okinawa was accomplished.

b. The 21st Bomber Command, also in the Marianas, was directed to make photoreconnaissance of the Nansei-Shoto between 9-20 March. Actually, however, the 21st Bomber Command had already taken some excellent pictures of the area as early as 29 September 1944.

c. The 14th Air Force, in the China Theater, was to strike Hong Kong installations and mine the harbor for three days starting 18 March, or L—14.

d. The Strategic AF, Pacific Ocean Area, also based in the Marianas was given the mission of neutralizing the Nanpo Shoto, which includes the Volcano and Bonin Islands; and of striking air installations in Japan as practicable. Search for and destruction of enemy picket boats was also required of this Air Force.

e. The Southwest Pacific Area AF, was directed to attack enemy air bases on Formosa in coordination with the B-29 strikes from the Marianas. This force was also required to furnish an offensive screen of navy long range patrol bombers against enemy search planes and patrol vessels in order to cover the water movement of forces approaching Okinawa.

f. A Carrier Force, TF 58, was to make strikes on Jap air installations on Formosa, the Pescadores and Sakishima Gunto on L—14 (18 March), in coordination with the land based B-24s and B-29s. Then,

after striking Okinawa on L—9, and the two succeeding days, the carriers were to operate eastward of Okinawa to support the assault, if needed. They were also to neutralize, without orders, any active fields on Tokuna, Kikai Jima and Minami, three small islands north of Okinawa. This force was also to stand by to augment the direct support of the escort carrier force if called for by the Commander, Joint Expeditionary Forces. Later developments changed the mission of this carrier force.

g. Escort carriers were to provide air cover for the approach and assault by the expeditionary forces. Also, to provide aircraft for air defense until fields on Okinawa were usable. In addition, they were to maintain sustained neutralization attacks on Okinawa and adjacent islands beginning about L—7.

h. An Amphibious Support Force was responsible for establishing a floating seaplane base in Kerama Retto, which was accomplished on schedule.

i. Transport carriers brought replacement naval aircraft, and some of those of the Tactical Air Force to the objective area. The land based air operations were carried out as directed. Hong Kong, Formosa, the Pescadores and Sakishima Gunto were successfully neutralized.

Task Force 58 broke off from the Iwo Jima engagement late in February and steamed westward to Nansei-Shoto. There, on 1 March, planes were launched for a reconnaissance of the islands, which was conducted with no material Japanese opposition. The resulting photographs were of excellent value in bringing the early pictures made by the 21st Bomber Command in September 1944 up to date. The force then retired to Ulithi for a ten day period of regrouping and logistic replenishment.

On 14 March (L—18), the Task Force departed from Ulithi and proceeded directly to Japan. On 18 and 19 March, from a position 100 miles southeast of Kyushu, air strikes were launched against airfields to eliminate future air resistance to our Okinawa operation. Enemy fleet units at Kobe and Kure were also attacked with considerable success. The force then slowly retired southward, continuing strikes on Jap airfields.

In this four day engagement, Task Force 58 destroyed 528 enemy planes, damaged sixteen surface craft and smashed scores of air installations. Our own air losses were 116 planes. As a result of this operation, the enemy was unable to mount any strong air attacks against our forces on Okinawa for a week after the initial landing. On 24 March, the battleships of the carrier force bombarded the southeast coast of Okinawa as a diversionary move to cover the actual location of the landing beaches.

When the invasion of the island started on 1 April, the carriers began a series of almost continuous strikes and combat air patrols in direct support of the landing. For a few days there was little enemy air opposition, then on 6 April, wave after wave of Jap fighters, bombers and *kamikazes* came crashing in against ground forces and supporting naval units. On this one day 248 enemy planes were knocked down, at a cost of only two of ours. These statistics are cited merely to indicate the ferocity of the enemy attack.

The Carrier Force then proceeded northward, and, on 7 April, attacked strong Japanese fleet units in the East China Sea, off Kyushu; sinking one battleship, one cruiser and four destroyers. From then on, for the balance of the operation, the force was engaged in alternately repelling suicidal air attacks at Okinawa and in striking Kyushu.

The carriers withdrew from the operation on 10 June, and retired to the Gulf of Leyte to lick their wounds; of which they had plenty. The box score for this

force alone over a period of nearly three months was over 2,300 enemy planes destroyed at a cost of less than 600 of their own aircraft.

A British carrier force was also assigned to the Fifth Fleet to assist in the air support of the Okinawa assault. From 26 March to 20 April, and again from 4 May to 25 May, planes from this force repeatedly struck Sakishima Gunto in support of the main effort. Despite heavy Japanese air attacks not one of the ships of this force was put out of action.

Tactical Air Force Ryukyus was the designation of the air component of the force which occupied Okinawa. This air force consisted of a marine aircraft wing, an AAF fighter wing, a bomber command and necessary air service units.

When this air force was activated in Oahu, in December 1944, there was a reluctance on the part of the furnishing agencies to provide staff personnel of adequate rank and experience for the necessary planning. Many members of this staff continued for some time to perform part time functions in other Hawaiian air commands.

The units comprising the air force were widely scattered, and as a result, loading and embarkation took place on the American west coast, the Hawaiian area, the Marshalls, Russels, Marianas, Western Carolines, and the Philippines. Two groups of marine day and night fighters were catapulted ashore from the escort carriers on 8 and 10 April. During the period ending 30 June, two additional marine fighter groups and three army fighter groups were called in and became operational. There were also three marine night fighter squadrons, one army night fighter and two marine torpedo bomber squadrons placed in operation on Okinawa and Ie Shima during that period. In the meantime an army medium bomber group had arrived, and two heavy and one light army bomber groups had been ordered in. None of the Army Air Forces tactical airplanes arrived until the middle of May.

The general mission of the Tactical Air Force was to occupy air bases when secured and commence tactical operations in support of the assault forces, and to assume the responsibility for air defense as rapidly as the situation ashore permitted. The specific mission of this force consisted of three phases in the following order of priority:

a. To gain air superiority by means of destruction of enemy aircraft in the air and on the ground, and by attacks on enemy air installations.

b. To prevent the movement of hostile troops and supplies into or within the objective area.

c. To give direct support to the ground forces in the battle area.

The Commander, Joint Expeditionary Force had control of all aircraft in the operation during the assault.

Coordination of ground forces and support was exercised by the commander, Air Support Control Unit afloat during the initial assault, and after the beachhead was firmly established by three landing force air support control units, one with each corps and one in overall control with the Army. These units controlled all aircraft, both carrier and land based, allocated for ground support by the senior commander, Air Support Control Unit, acting in the name of the Expeditionary Force commander. Air defense remained with the above control agency until the Air Defense Command was fully operational ashore and radar installations were functioning. However, the Air Defense Command remained under the operational control of the commander, Air Support Control Unit, until the island was secured.

In the majority of cases, close coordination existed between artillery, naval gunfire and air support. This was particularly true when the Air Support Control Unit

and the naval gunfire officers were right in the artillery fire direction center.

Except in some cases where called air assaults arrived late, the air support was generally excellent. Good ground targets were scarce and small so large air strikes employing more than one or two squadrons were hardly ever profitable or required. The Japs in their inter-connected caves were hard to get at. Small bombs were useless, and napalm would only burn off the camouflage around the cave mouths. It was found, however that thousand pound bombs with delay fuzes would seal caves or shake down the roofs.

Air bases on Okinawa were developed under control of the island commander. Both Yontan and Kadena airfields were secured by 1300 on L-day, and Yontan was ready for emergency landing on 3 April. The land based fighter groups started operating from Yontan on L+7, and two days later also from Kadena. Heavy enemy air attacks toward the end of the first week diverted most of our planes from the direct air support of our ground forces. Definite air superiority was maintained throughout, even though many enemy planes did manage to slip through our defense. The ring of radar picket ships took the worse beating, however, from nearly continuous Jap air attacks, including many *kamikaze* attempts. This called for fighter cover for those ships, and further reduced the number of fighters available for ground support. Starting on L+8, C-54 transports were employed in the air evacuation of casualties. During the first seventy-five days of the operation, over 15,000 casualties were moved out by this means. L-5 aircraft were also used for this purpose after their arrival on L+35 and in one nineteen day period evacuated 1,200 casualties.

The aspects of our National security have changed many times since the Marine Corps was established 171 years ago. The basic concept, however, which brought the Marine Corps into being has not changed, but has been expanded, strengthened and reaffirmed by frequent, and recent, demonstrations. This concept envisions that our national security requires that the Navy have ever at its disposal a body of fighting troops, thoroughly indoctrinated in Navy ways, subject to naval command, discipline and law, and specially trained to perform military duties of an essentially naval nature.

The U.S. Marine Corps is such a body.

General Alexander A. Vandergrift

Advanced Naval Bases

Rear Admiral M. R. Browning, *United States Navy* (Retired)
Former Director, Naval Section, Command and Staff College

BROADLY speaking, a naval base may be defined as an organized locality equipped to sustain naval operating forces. A U.S. Naval Advanced Base is one situated outside the continental limits of the United States. Naval bases, no matter what their location, are classified as either *Major Bases* or *Minor Bases*. A major base is a concentration of activities which includes all the facilities necessary to support *all* types of naval forces in all manner of operations. A minor base is a concentration of service and logistic agencies which is limited in its facilities to general maintenance of certain classes of ships or forces, or to exclusive support of one or more specialized types such as submarine, aircraft, destroyers or amphibious forces. Minor bases are normally given designations appropriate to their special functions, as for example, a Submarine Base, Air Base, Destroyer Base, etc.

In World War II the vital importance of advanced bases to support the combat operations of our armed forces was emphasized as never before in our history. The terrific price we had to pay in men and money for our pre-war policy of neglecting the establishment and maintenance of strong advanced bases in the Pacific needs no elaboration. It is to be devoutly hoped the country has learned the great lesson that to the United States war means amphibious war if we would keep our shores safe from invasion, and that the prior establishment and continued maintenance of strong outlying base chains is a fundamental "MUST" in our pattern of security. Atomic and guided missile developments of the coming years do not change this premise; indeed to the thorough student of war they spotlight its essential soundness even more sharply than before. No matter what the destructive agent which man may develop, and no matter what the vehicle he may devise to carry it to its objective, the basic equation of logistics will never be altered, viz., the cost of operating varies directly as the square or cube of the distance from the base.

An advanced base has only one reason for its existence; that is to support the operating forces. This fact is the "common denominator," so to speak, of the plans for, and the establishment and operation of, any overseas base. It is a first fundamental in evaluating an existing base or in considering the merits of any locality for the prospective establishment of one. The value of a base depends upon its location, its resources and its strength. Any island or point along a coast which is accessible by sea, which is proximate to an operating area, and which possesses an anchorage and a little flat terrain, can be turned into an advanced base fairly quickly. The state of development of local resources in such a spot will have a direct and vital bearing on the length

of time required for the establishment of the base and upon the scope of its functioning thereafter.

The Advanced Base Service

The Advanced Base Service was organized with offices on the Eastern, Gulf and Western seaboards of the continental United States. Each office was headed by a Director with full authority to act in all matters pertaining to the units and functional components within his area of control. At the home coastal ports of his zone, he coordinated the assembly, the inspection, and the preparation for overseas shipment of all material and equipment destined for Advanced Base establishment. He also supervised the assembly, organization and training of the personnel, both officer and enlisted, to build, man and operate the Advanced Base installations at the projected site. When shipping carrying an echelon of the Advanced Base Units or the Functional Components arrived in the destined theater of operations, the units and Components passed under the control of the Theater Commander, who was responsible for their establishment at their selected location and for their administration thereafter. Once set up, the base was supplied and replenished in the normal manner by the Theater Service Force.

The Advanced Base Service performed near-miracles in reducing the time and expense required for the efficient processing of the Base Units and Components. The system followed by the Service resembled somewhat that which has long been followed by U.S. rail transportation in the assembly of railroad trains, particularly freight trains. Each railroad procures from contracting manufacturers a supply of cars built to its specifications. The cars are of many different types, each type being specially designed and constructed to meet a specific kind of hauling duty, such as refrigeration, bulk liquid (tank), box, flat, gondola, etc. In addition to its special features, each car is equipped with standard gauge wheel trucks and standard coupling assemblies, including air, steam and electrical connections, so that it may be assembled into any U.S. standard railroad train and operated on any U.S. standard gauge track. New cars and those not actually in use are stocked in the marshalling yards of the road, whence they are drawn and assembled into trains to meet the requirements of industry and traffic. Except for the limitations inposed by terrain, road gradients and locomotive power, there are no restrictions on the workable variations in the numbers or types of cars or their sequence in the train assembly; any type car will function equally well no matter what the types of its immediate neighbors. The train is an efficiently integrated assembly featuring a high degree of flexibility. The same result was sought—and obtained—by the Advanced Base Service in the components and units which it made up, trained and loaded into the outward bound shipping. They were sub-assemblies like the freight cars, each built to the specifications required by its peculiar mission in the over-all plans for the base, yet also equipped for close coupling with, and smooth operation adjacent to, its neighboring sub-assembly. The Advanced Base Service functions bore one further analogy to those of the railroad, in that the marshalling of the units and components for a projected base into the successive echelons of the shipping flow to the parent theater presented problems of timing and sequence in the relative positioning of the parts—i.e., the cars—exactly similar to those in the switch yards when a freight train is made up. The Advanced Base Service Office acted as the yard switching engine in that phase of its operation.

Types of Units

The Advanced Base units were basic organizations which were provided with

standardized equipment and personnel allowances. They were given the unclassified code designation of "Acorn," "Cub" and "Lion." In their final forms, each of them comprised a number of functional components which varied in size and personnel strength to conform to the primary mission of the parent unit. Some of the functional components were common to all three of the basic type units. The units themselves, as well as the components, could, like the freight train, be tailored to the requirements of any particular mission by reduction in, or elimination of, such functional components as were not necessary in full normal strength, and by the addition or reinforcement of such others as the situation indicated.

The *Acorn* was a minor Advanced Base assembly and constituted the smallest of the three integral units. It comprised the building, maintenance and operating establishment for a unit air facility. It was designed for the purpose of quickly constructing an advanced airfield in undeveloped terrain, or for the swift repair and operation of a newly seized enemy air installation. When augmented by the ground complements of the combat air units, the Acorn provided accommodations and equipment adequate for sustained operation of one shore-based Carrier Air Group and one Fleet Patrol Squadron. When the ground complements of the air units were not present with the Acorn, the personnel of the latter were sufficient only to maintain the air base equipment in operating condition, to service casual aircraft, to operate the field lighting, air warning and local transportation systems, and the berthing, messing and medical activities for its own organization. The functional components of the Acorn included the assemblies for two landing mat runways, each 6,000 feet in length, and for wire mesh seaplane ramps if seaplane activities were to be provided for. If only one type of operations were envisioned, i.e., landplane or seaplane, then only the appropriate component would be "coupled in." The Acorn in its standard form did not include harbor equipment such as nets, booms, radars, weight handling machinery, etc. Acorns were frequently incorporated into larger base assemblies comprising either Cubs or Lions and, when this was the case, all harbor and other extraneous equipment was included with the larger parent unit. When, however, the Acorn was alone and such components were needed, they could be ordered by the Area or Theater Commander in advance from the catalogue and assembled with the Acorn, either initially at the shipping point or later at the site of the establishment. In like manner, the Acorn could be —and frequently was—provided with close-in defense weapons including automatic antiaircraft batteries and the necessary trained personnel to man them.

The *Cub* was a minor Advanced Naval Base assembly considerably larger than the Acorn both in size and in the scope of its activities. It normally comprised the equipment and the specially trained crews to establish an advanced fuel and supply base in undeveloped territory. The Cub was designed to be adequate to provide logistic support, except material repairs, to a group of fleet light surface forces. The replenishment needs of battleship and aircraft carrier elements of the fleet, and the problems of ship overhaul and damage repair, were beyond the normal capacity of the Cub to handle. Air maintenance and operating facilities were usually added to each Cub, this being accomplished normally by the assignment of two reinforced Acorns to it.

The *Lion* was the largest of the three basic Units. Its approximated a portable navy shipyard in size and nature. It was designed to furnish the advanced base with the facilities needed for logistic support of a major task force or a fleet. Its installations normally included, in addi-

tion to supply, replenishment and maintenance activities, provisions for making repairs to both submarines and surface ships of all types. Four Acorns, reinforced by certain additional functional components, comprised the normal allocation of air operating, maintenance and repair facilities to a Lion.

The concept of the Advanced Base Units and their functional components was one which became fully crystallized and matured only after we had acquired considerable and frequently bitter experience in our westward advance in the Pacific. The original prospectus of the unit assemblies was adopted soon after the Pearl Harbor attack. The selection of the code names "Acorn," "Cub" and "Lion" followed shortly thereafter. By the time we made our original landing on Guadalcanal and Tulagi, in August 1942, we had two "Cubs" in readiness to go into the newly seized positions and proceed with their development. However, valuable as these steps forward in the fields of logistic thinking and preparation proved themselves to be from the outset, they quickly demonstrated a number of serious shortcomings. These were discerned to stem from the fact that the units were far too large and unwieldy to possess the great flexibility which was indispensable. The lost motion and the wastage of men and materials in the assemblies was still far greater than we could afford. The functional component phase of the program was devised and adopted to ameliorate these drawbacks. The system was a success from the first. It resulted in the practical elimination of the awkwardness and lack of adaptability of the unit assemblies as originally set up. By the end of the war in the Pacific, we had completed some four hundred Advanced Naval Bases in the theater, varying in size and function from small specialized installations to such huge establishments as the Fleet Bases at Guam, Leyte-Samar and the Manus Islands. The base at Okinawa, upon which construction was well advanced when VJ-day rolled around, would have been, when completed, the most enormous such military construction project in the history of mankind. The plans included twenty-eight airfields and over 1,000 miles of heavy duty roads together with collateral installations such as supply depots, bulk fuel storages, harbor developments and facilities, public utilities, etc. It has been estimated by qualified experts that the work scheduled for the development of the Okinawa base, if undertaken in the vicinity of New York City under the conditions existing at the time, would have cost $200,000,000. Of this total, we had already completed some $60,000,000 worth on VJ-day, according to a statement by Admiral Moreell, USN. In all, about 65,000 special construction personnel, Seabees, Army Engineers and Naval Civil Engineers were engaged on the project.

The Gropacs

As experience grew in the handling of the problems of selecting suitable components and tailoring them to the peculiar requirements of the different overseas sites, the need became apparent for better preparation of organized harbor crews. Every base which we established in the early months of the war found itself severely hamstrung by the inadequacy, both at the outset and continuing later, of its harbor and water front development. Accordingly, an organization was designed, whose specific mission was to install and operate all water front and harbor fixed installations and facilities together with certain of the harbor fixed defenses, at an advanced base. This organization was designated as "Gropac." Normally, the list of the responsibilities of a Gropac included: the building and maintenance of docks, piers and moorings; installing and maintaining navigational aids in the harbor and its approaches; installation

and maintenance and operation of nets and underwater sonic devices; defensive mine fields; unloading of cargoes; providing and operating a small boat pool for use within the harbor; repair and maintenance of small craft and barges; operation of local harbor and net patrols. The Gropac proved its worth at once. Its appearance in the Pacific was followed immediately by measurable reductions in the unloading and turn around times required for shipping into advanced bases. Much needed improvements were made by the Gropacs in the berthing, port handling and cargo discharging equipment and facilities at the existing advanced bases, as well as in the design and assembly on the mainland of such gear for future establishments. Under the Gropac system, the cargo tonnage unloaded at advanced Pacific bases by the Seabee stevedore battalions rose to a tremendous peak figure of a million and a quarter measurement tons in the month of July 1945. The Gropac was soon given the status of a commissioned unit under a naval commander. Its status was thus more nearly that of a unit assembly than that of a functional component, but it was, of course, useless by itself and was invariably associated with one or more of the three base unit assemblies. Gropacs averaged generally a personnel strength of about 250 officers and 3,500 men.

Rolling Up

As our forces tightened their grip on the throat of Japan and the lines of action contracted around the enemy main islands, we rolled up those advanced bases which had been established earlier in the South and Southwest Pacific Areas and moved the vast accumulations of men and material forward. For example, for the Okinawa campaign, more than 400 ships and upward of 100,000 combat officers and men were staged through South Pacific bases. All this shipping received complete logistic service, including overhaul and repair, at those bases during the entire period of concentration and assembly for the operation. Then, hard on the heels of the displacement forward of the troops and combat matériel, the bulk of the services and facilities at those bases were similarly picked up and shifted forward. This roll-up system was carried out similarly and concurrently in Australia and New Guinea.

Summary

Our Advanced Naval Bases played a vital role in the winning of World War II. In the defeat of Japan, the role was a dominant one; we could not have won that victory without them. Although our planned Kyushu invasion never became necessary, as it turned out, nevertheless the very fact that we could plan and actually take the initial steps in such a vast logistic undertaking was the direct outcome of our successful establishment and operation of our advanced base organization west of the International date line. In the field of support and service for combatant forces of whatever nature, the war witnessed greater technical advances than any dreamed of a few years before. The amazing evolution of our Advanced Naval Base system of unit assemblies and functional components heads the list of those advances.

Employment of Tanks
by the
Infantry Division

Lieutenant Colonel Harry L. Hillyard, *Infantry*
Instructor, Command and Staff College

In a recent study of Army Ground Force battle casualties, it was indicated that one cause of casualties among front-line infantrymen and tankers working with infantry divisions, was the lack of understanding and cooperation between the two. Some of the examples cited were:

(1) A separate tank battalion commander, newly attached to a division, was ordered to place his tanks in the front line on a forward slope and hold, while the infantry withdrew for the day. He lost two-thirds of his tanks and was about to be investigated by an officer of the Army Armored Section, but before the investigation could take place he was surrounded, and could not be reached.

(2) A certain infantry company lost twenty-seven men killed in action from *Schu* mines because the tanks would not operate at night and make a path through the mine field.

(3) One tank battalion commander said, "I took that damned hill three times and each time had to withdraw because the infantry did not back me up."

(4) An infantry battalion commander said in desperation, "Let my men drive your tanks into the town if you claim it is against doctrine." He did it without the loss of a single one of the seven tanks given him.

From the above, and other studies it is apparent that cooperation and mutual confidence between the tankers and the infantrymen was not always what it should have been. Much of this was caused by lack of opportunity, or failure to train together before going into combat. Also in many cases, for reasons which will be discussed later, infantry division commanders were forced to employ their attached tank battalions in roles that could be considered contrary to accepted pre-war doctrine. The usual procedure was for the division to attach the tank companies to the regiments, and the regiments in turn to attach a platoon to each infantry battalion, regardless of the tactical situation, mission, or terrain. The tank battalion was seldom, if ever, used in mass, as contemplated by FM 17-36, to take advantage of its mobility, great firepower and shock action, although there were many occasions when an infantry division battled all day and suffered severe casualties to take an objective that could have been taken in a few minutes by the coordinated attack of a tank battalion.

Experience showed that common violations of the more important fundamentals laid down in FM 17-36 were:

(1) Failure to make profitable use of tanks when available.

(2) Failure to employ tanks in mass. (The battalion is the normal unit of employment.)

(3) Failure to concentrate tanks at the decisive place and at the decisive time.

(4) Failure to secure complete control and coordination. There must be adequate communication between infantry, tanks, and artillery and *command must be definitely established.*

(5) Failure to use the tank as an offensive weapon, thereby sacrificing its characteristics of armored firepower, mobility and shock action for which it was designed.

Tanks will be Available

Since the newly approved infantry division for the future (Figure 1) has tanks, it is imperative that all commanders and their staffs understand how to employ these tanks so that objectives can be seized and held with a minimum of casualties to personnel.

Use of Armor by Corps and Higher Commands

Before discussing the use of tanks by the infantry division, let us consider how the armored and infantry components of the combined arms were coordinated by higher commanders during the recent operations in the ETO. From a study of these operations, reports of the ETO General Board, and the field manuals, it becomes apparent that the principles of employment laid down in the field manuals are sound, and that corps and higher commanders applied these principles with great success. Starting with the invasion of Normandy, they used their infantry divisions, supported by tanks, artillery, and air power, to create the conditions favorable to the employment of armor, and then used their armored divisions, supported by infantry, artillery, and air, to exploit them.

Full advantage was taken of the mobility, firepower, shock action, flexibility and great offensive power of the armored divisions. Outstanding examples are the dash across France, Belgium and Holland to the Siegfried Line; the use of armored divisions to counterattack and destroy the German armored units in the Battle of the Bulge; the seizing of the Remagen Bridge; the envelopment of the Ruhr; and the dash from the Rhine to the Elbe. In all of these operations the armored divisions were used to move forward rapidly and seize the critical objectives whenever possible, while the infantry divisions followed to mop up, occupy, organize and defend.

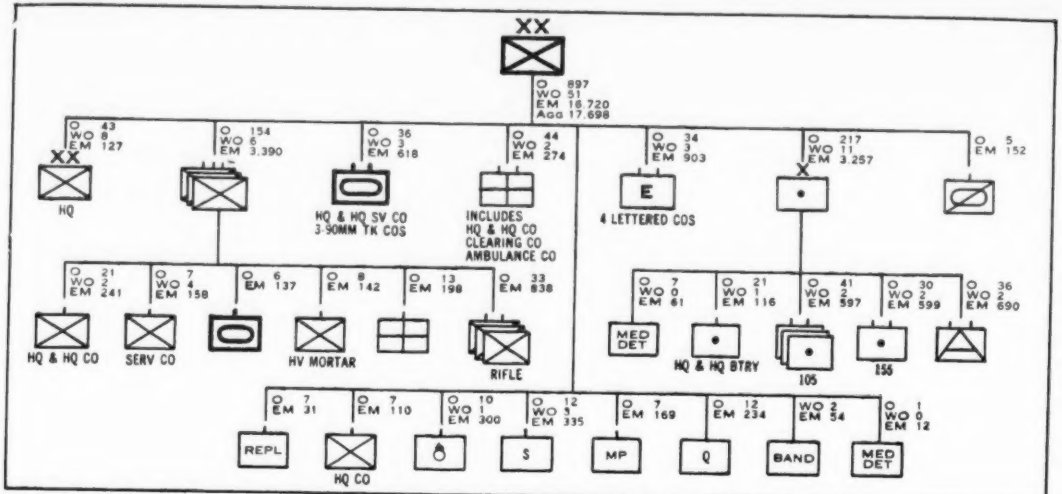
Use of Tanks by Armored Divisions

At the division level, and considering only the armored division, we again find many examples of the proper employment of armor. True, there were instances of improper employment, such as in the Vosges and in the mountains and towns in Italy. In many divisions, however, when the situation and terrain permitted, tanks were employed in mass to take the main objective. It was definitely proved that, deployed on suitable terrain, a tank battalion with all weapons firing, supported by artillery, and especially if supported by fighter bombers, could move from one objective to another against determined resistance. The main difficulty experienced in the armored division was lack of sufficient infantry to come forward quickly to mop up, organize and defend the ground gained so that the tank battalions could be relieved to reform, reservice, and prepare for the next attack.

Use of Tanks by Infantry Divisions

From the above discussion we see that commanders of armored divisions, corps and higher units employed their armor in mass at the critical time and place to gain decisive results. In the infantry division this was not always true.

Normally, a tank battalion was attached to each infantry division before it was committed to combat. As mentioned before, it was a common practice to attach one medium company to each regiment, and for the regiment to attach a platoon to each infantry battalion, regardless of the



Organization chart for the INFANTRY DIVISION. Major items of equipment for the division will be as follows:

A—Airplane, Liaison 16
E—Boat, Utility, Medium 2
E—Bridge, Floating, M-4A2 ..... 250 ft.
E—Compressor, Air, Truck-Mounted 6
E—Crane, Truck-Mounted, 4-8 ton, Powered 5
E—Power-Plant, 5-kw, Trailer-Mounted 1
E—Semitrailer, Low Bed, Front-Loading, 20-ton 4
E—Shop Equipment, Motorized, General Purpose 1
E—Tractor, Diesel-Driven, 35 to 40 DBHP 1
E—Tractor, Diesel Engine Drive, 61 to 90 DBHP 6
E—Trailor, Full Low Bed, 8-ton 1
E—Trailer, Utility, Pole Type, 2½-ton Type 1 13
E—Vehicle, Engineer, Armored, Tank-Dozer Type 7
E—Water Purification Equipment, Distomite, Portable, 35GPM, Set No. 3 4
E—Welding Equipment, Set No. 1, Electric Arc, Trailer Mounted 1
M—Truck, 2½-ton, Dental Laboratory 1
O—Car 5-Passenger, Medium, Sedan 1
O—Carriage, Motor, Multiple Gun M-16 32
O—Carriage, Motor, Twin 40-mm Gun, M-19 32
O—Carrier, Personnel, Full Track, Armored 17
O—Gun, Machine, cal. 30, Heavy 60
O—Gun, Machine, cal. .30, Light 147
O—Gun, Machine, cal. .50 297
O—Howitzer, 105-mm 54
O—Howitzer, 155-mm 18
O—Mortar, 60-mm 81
O—Mortar, 81-mm 39
O—Rifle, 57-mm Recoilless 81
O—Rifle, 75-mm Recoilless 42
O—Truck, Light, with Armament 9
O—Tank, Medium, M-26 129
O—Tank, Medium, M-45 12
O—Tractor, Medium, M-5 24
O—Truck, ¼-ton 920
O—Truck, ¾-ton, Ambulance, KD 32
O—Truck, ¾-ton, Wpns Car 210
O—Truck, 1½-ton, Cargo 178
O—Truck, 2½-ton, Cargo 448
O—Truck, 2½-ton, Cargo, SWB 112
O—Truck, 2½-ton, Dump 48
O—Truck, 2½-ton, Signal Corps Repair 2
O—Truck, 2½-ton, Small-arms Repair 1
O—Truck, 4-ton, Cargo 1
O—Truck, 4-ton, Wrecker 7
O—Truck, 6-ton, Prime Mover 4
O—Truck, Wrecking, Heavy 4
O—Vehicle, Tank Recovery 8
O—Vehicle, Utility, Armored M-44 17
W—Mortar, Chemical, 4.2-inch 24

Figure 1.

tactical situation, mission or terrain. The tank battalion was rarely, if ever, assembled to lead the attack, or to repel a counterattack. In the few cases where the tanks were ordered to lead the attack, the unit employed was no larger than a platoon or company, and the attack was launched without the coordinated support of the artillery and other means available.

Reasons for Failure to Use Tanks in Mass

There were several reasons why the practice of parceling out the available tanks and tying a small tank unit up with a correspondingly small infantry unit became the accepted doctrine in the infantry division.

First, the antitank and cannon companies organic in the World War II infantry division were unable to furnish adequate direct fire support and antitank protection for the assaulting infantry. The tank or the self-propelled tank-destroyer proved more suitable for performing this accompanying direct fire mission. Second, as a result of the fighting in Normandy, the idea grew up that tanks and infantry must never be separated. Even in the armored divisions, during this period, a squad of infantry was desired in the immediate vicinity of every tank. This hedgerow fighting was a very special type of operation in which each field was a well organized compartment. If the tanks entered the field alone, they were vulnerable to bazooka fire or antitank guns in dug-in positions in the surrounding hedgerows. If the infantry lagged a few fields behind, they were mowed down from the four corners of the field by machine gunners who had been by-passed by the tanks. The successful method for cleaning out these fields was for the tanks and infantry to proceed together, the tanks blasting-out the corners with cannon fire and raking the edges with their machine guns before entering each field. The infantry entered with the leading tanks to probe the hedgerows and protect the tanks from bazooka and antitank guns. After this experience, the infantry seemed to feel that they could not advance under any circumstances without tank support. Later, it was felt that in any situation some tanks should be with the infantry to boost morale, if for no other reason. The third reason for not massing the tank battalion for attack resulted from the second. With only twenty-eight tank battalions available for forty-two infantry divisions, there simply were not enough units to have tanks accompany all the advancing infantry, and also have tank battalions available for purely tank missions. A last reason which applies not only to the use of tanks, but also to engineers and other supporting troops, was the tendency of some staffs to parcel out all attached units to the next lower commanders, so that when the battle started there would be no responsibility for movement or employment of these units on their shoulders. This "buck passing" continued until an attached battalion was broken up into platoons or sections, and each infantry headquarters, down to that of battalion was successively cleared of responsibility for the welfare and employment of the attached units.

In the present and future infantry divisions, with organic tanks in each regiment, the reasons for parceling out the tank battalion no longer exist.

Let us admit, then, that our tanks were not always used to the best advantage during the past war, and consider how the infantry division commander of the future should employ his tanks to inflict a maximum of destruction on the enemy with a minimum of casualties to his own forces. To do this we must consider the tanks available, the missions to be performed by them, and how the available tanks should be used on the various missions. The principles are applicable to either the present or future organizations.

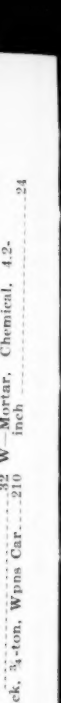


Figure 1.

Tanks Available to the Infantry Divisions

The present infantry division (T/O&E 7, 12 April 1946) has an antitank company with nine M-26 (90-mm gun) tanks and a cannon company with nine M-45 (105-mm howitzer) tanks organic to each of its regiments. In addition it is usual for the division to have a separate tank battalion attached for combat.

The future organization (Figure 1) has a tank company organic to each of its regiments and a tank battalion organic to the division. Each of the regimental tank companies has two M-45 tanks and four tank platoons, each equipped with five M-26 tanks. The organic tank battalion has three companies each equipped like the regimental tank companies. The total medium tank strength of the division is 141 tanks.

Tank Missions

Since tank destroyers have been eliminated from our troop list, tanks must perform the following missions:

(1) Provide antitank defense for the division.

(2) Provide direct fire support for the infantry.

(3) Take ground for the infantry.

(4) Make counterattacks to restore the position.

A brief glance at the above missions should indicate that the first two require specialized training of one type, and the last two specialized training of another. In the case of the first two missions, careful selection of positions, pin-point accuracy of fire, and close coordination and communication between individual tanks and the supported infantry are vital. On the other hand, to take ground for the infantry or to counterattack, requires coordinated action of tanks in mass, taking full advantage of speed, firepower, shock action and flexibility of formation on the battlefield. We might call tanks accompanying the infantry, giving direct fire support and furnishing antitank protection, *accompanying tanks* and those taking ground or counterattacking, *assault tanks*. Tank crews trained and experienced in the accompanying mission cannot be quickly assembled and formed into a provisional organization for a mass attack, nor will tank crews and platoons that have been trained and experienced in fighting as a unit perform well in an individual role on the accompanying missions. The organic tank company in the regiment is adequate to perform the close support, or accompanying mission. These tanks should be trained to work individually or in pairs, with the front-line infantry. They should operate under the command of the infantry commanders and understand the job of the infantry squad and section. With

M-26, "Pershing" Tank.
(U.S. Army Ordnance photo.)

M-45, Medium Tank.
(U.S. Army Ordnance photo.)

proper training they will give the direct fire support, antitank protection and moral support necessary to permit the infantryman to move forward with confidence. These tanks should not be called upon to lead the attack for the infantry regiment or battalion. If the terrain and mission is suitable for a tank attack, the mission should be given to the tank battalion.

How to Use the Tank Battalion

The important thing for the division commander to remember is that, like the corps commander, who has an armored division, he has, in the tank battalion, an armored striking force which under favorable conditions can:

(1) Seize and neutralize objectives until the arrival of the infantry.

(2) Regain the initiative by means of a surprise attack.

(3) Restore momentum to an attack which has bogged down.

(4) Break through on a narrow front.

(5) Exploit a success by overrunning enemy artillery and other rear installations.

(6) Envelop and seal off small villages, woods and other pockets of resistance.

(7) Form the basis of a task force to seize distant objectives vital to the conduct of future operations.

(8) Cover a withdrawal, by counterattacking or blocking.

(9) Form a mobile reserve prepared to counterattack enemy mechanized or airborne penetrations while awaiting opportunity for offensive action.

(10) Furnish a mass of direct fire support for a river crossing or for an attack of a fortified position.

To help decide when and where to employ the tank battalion, the mission of the division should be broken down into objectives. Each objective will be primarily an infantry objective or an armored objective. In other words, each objective or intermediate objective can best be taken by *infantry* supported by tanks and other arms, or by *tanks* supported by infantry and other arms. For example, if the mission involves penetrating a woods and continuing on to seize a commanding position in open rolling terrain, the penetration of the woods is primarily an infantry mission. The attack of the position in the open is primarily an armored mission. If the mission involves taking a town, the envelopment of the town is a tank mission, and the clearing of the built up area is an infantry mission. Once the decision is made that the main objective is suitable to armored attack, all other means should be subordinated and coordinated to support the tank attack.

From the discussion so far, it can be seen that there will be many cases when the infantry division commander can take his objective quickly by launching a successful tank attack with the infantry merely moving onto and organizing the position. The question, what makes a tank attack successful, is the one that must be mastered by infantry commanders. The following points are offered as the result of combat experience:

First, the terrain must be favorable to mass employment of tanks. There must be room to deploy, and the soil between the line of departure and the objective must be trafficable.

Second, against organized resistance the attack must be coordinated. Violation of this principle, when committing attached tank battalions, caused the attempts of some commanders to fail. Such orders as, "get up the valley as rapidly as possible," "support the attack of the infantry" (location unknown) and, "continue without pause" are examples from the past war of insufficient and faulty coordination.

The following points of coordination have proved practical and successful:

Any tank attack should have artillery support. This tank-artillery coordination is vital, and with a little training can be more flexible and more highly developed than that in the infantry-artillery team. Every tank commander has a radio and can act as an artillery observer. One or two artillery observers with the battalion can relay requests from the tank commanders, platoon leaders or company commanders. In any attack, be sure that the artillery is prepared to receive radio requests for fire from the tank battalion.

Coordination between fighter-bombers and tanks can function as in the infantry-artillery team. With a little direction from an air control officer in a tank, and by observing the fire of the tanks moving in deployed formation, the fighter-bombers can furnish very close support.

The fires of all infantry weapons including the accompanying tanks should be coordinated to furnish valuable fire support and flank protection for the assaulting tanks.

Probably the most important single factor contributing to the success of an attack by the tank battalion is complete command and control of the tanks during battle. In all cases when the tanks lead the attack, control should be exercised through tank commander channels. With good radio communication and a thorough understanding of the situation, tank formations are extremely flexible and can be controlled by the tank commander. The tank battalion is a weapon of the division commander, and normally the responsibility for assignment of missions and employment should not be delegated.

Four possible organizations for command are suggested, depending on the mission of the tank battalion:

(1) *Tank battalion under division control.*—In this case the tank battalion commander is in command and operates on orders from the division commander. This should be normal when the battalion has the defensive role of reinforcing and deepening the antitank defense, and of being prepared to counterattack.

(2) *Tank battalion as Task Force under division control.*—In this case the tank battalion commander is in command of the combined force of tanks, supporting infantry and engineers. Artillery, and possibly air, may be in direct support. This organization is suitable for a mobile force hastily organized, to seize and hold critical points pending arrival of the division; for a close-in envelopment; and for counterattacking a hostile penetration.

(3) *Tank battalion as part of a Task Force commanded by the assistant division commander.*—When the infantry element required in the task force is a battalion or more, a higher commander, such as the assistant division commander, capable of deciding the tank mission and the infantry mission without prejudice, should be in command. He should assign the tank mission to the tank battalion commander and the infantry mission to the infantry commander. This force would be especially suitable for any mission of vital importance to the division where the tank battalion might be used. For example; to seize a distant objective vital to future operations; to make a wide envelopment; or to cover a withdrawal.

(4) *Tank battalion attached to the infantry regiment or combat team.*—When the main effort is to be made in the zone of one of the regiments, the tank battalion may be attached, and the regimental commander will be in command. However, when the tank battalion is attached, the regimental commander becomes a task force commander and should turn over the direct command of the infantry elements to one of his subordinates. He must decide for each objective whether the tanks or the infantry are to lead the attack, he must see that

artillery support and all other means are employed to assist the assault force, and having decided on the tank mission and the infantry mission, he should issue orders, and control each, through their respective command channels. The important thing to remember in any of the above situations is that command and control of the infantry and tank forces must be complete. Someone must decide what the tank battalion will do, and what the infantry will do. Once the decision is made, orders are issued to the tank battalion commander and to the senior infantry commander, who, in turn, become responsible for the proper performance of the tasks assigned their commands.

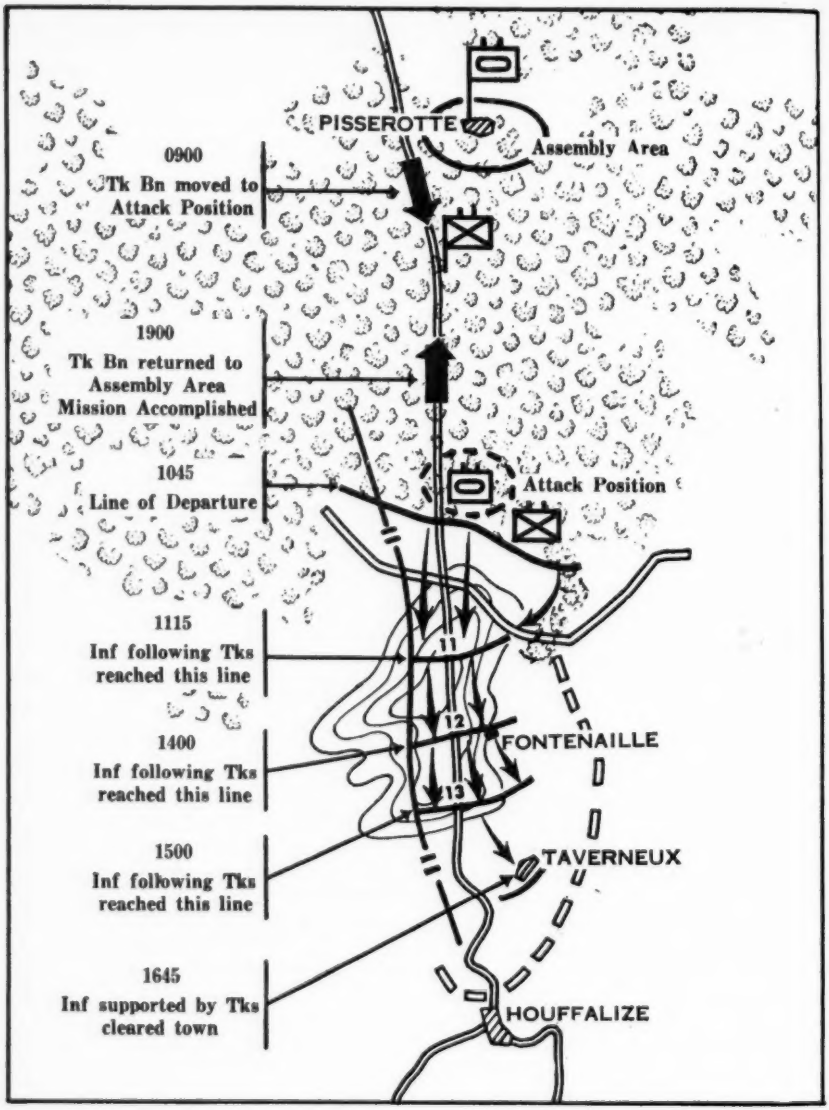
Having decided that the terrain is suitable for a mass tank attack and how the attack is to be supported, coordinated and controlled, the time for the attack is the next important consideration. True, the tank battalion is a highly mobile force and can move quickly to distant objectives. However, an attack against strong resistance must be coordinated to be successful. For such an attack much preparation is needed. Crews must be alerted, vehicles and weapons checked, radios netted with cooperating units, reconnaissance made of routes to jump-off positions, crews briefed, and many other details attended to. All of this takes time, and can be done thoroughly only in daylight. If possible, the attack should be sand-tabled so that infantry and tank personnel understand what the other is going to do.

An attempt to attack at night or at daylight will usually result in confusion and a piecemeal effort. Time should be allowed in the attack position for final briefing, reconnaissance and coordination during daylight. It is better to delay the time of attack for several hours, and have it jump off with all guns firing, and roll to the objective, than to launch an uncoordinated attack at daylight, have it stopped, and suffer heavy casualties all through the day. Timing the final attack of the day so that the supporting infantry will arrive on the position just before dark usually throws the enemy off balance and allows time to organize the position before he can counterattack.

In order to show how some of these principles were applied in combat, a brief historical example of an attack by a tank battalion of the 2d Armored Division in conjunction with an infantry regiment follows. The same attack might well have been made by a tank battalion attached to, or organic to, the infantry division, and is an example of how the tank battalion can be used to take ground for the infantry.

Historical Example

The action occurred during the final phase of the Battle of the Bulge. The situation at dark, 14 January 1945, is shown, in part, on the map page 58. The Germans were resisting desperately with self-propelled guns, dug-in infantry, road blocks, mines and artillery fire. We were attempting to cut off his salient at Houffalize. At dark, 14 January, the tank battalion had assembled in the vicinity of Pisserotte, and the infantry had pushed to the edge of the woods to the south. Verbal orders were issued at 2300, at headquarters, Combat Command "B," for the tank battalion to attack south through the infantry line to seize objective 11, and continue on to the high ground overlooking the towns of Taverneux and Houffalize. A platoon of engineers with two mine exploder tanks, and a platoon of tank destroyers were attached to the tank battalion, and a battalion of armored artillery was to be in direct support for the attack. The infantry was ordered to follow the tanks closely and take over the ground gained. Time of attack: 1045. From the tank battalion


PISSEROTTE
Assembly Area
0900
Tk Bn moved to Attack Position
1900
Tk Bn returned to Assembly Area Mission Accomplished
1045
Line of Departure
Attack Position
1115
Inf following Tks reached this line
11
12
FONTENAILLE
1400
Inf following Tks reached this line
13
1500
Inf following Tks reached this line
TAVERNEUX
1645
Inf supported by Tks cleared town
HOUFFALIZE

point of view the sequence of events until the completion of the mission was as follows (times except time of attack are approximate):

15 January 0001-0045: A conference was held with the infantry regimental and battalion commanders, and the supporting artillery commanders. It was decided that the 3d Infantry Battalion, supported by the light tank company and the platoon of tank destroyers, would move promptly onto each objective taken by the tanks and would hold it while the assault on the next objective was being organized. An intermediate objective (12), and the final objective (13) were selected. The infantry regiment, with supporting tanks from another battalion would take over the final objective when it was reached.

0045-0115: The tank battalion commander returned to his command post at Pisserotte.

0115-0200: The tank battalion staff was briefed and orders were issued for company and separate platoon leaders to report at 0800 prepared to make a reconnaissance of the attack position. The battalion was to move south on the Houffalize road at 0900 under the executive officer.

0800-0930: Company commanders and separate platoon leaders were briefed and taken forward for reconnaissance with infantry commanders.

0930-1940: Vehicles were guided into attack positions. Platoon leaders and crew commanders were briefed and had a look at the first objective.

1042-1045: Artillery, mortars, and assault guns fired the preparation.

1045-2300: The battalion attacked in column of companies astride the main road with all guns firing including the indirect support from mortars, assault guns and artillery. The engineer platoon with two mine exploder tanks followed abreast of the third wave and cleared the highway of mines. The infantry battalion covered by the light tank company and a platoon of tank destroyers moved up the draw on the left, and avoided artillery and antitank fire directed at the tanks. The tanks moved directly to objective 11 with the loss of one tank and one man killed. The infantry arrived promptly and cleared out the woods. At 1115 they were along the line shown on the map at 11.

Considerable antitank fire was received on the position at 1130, and the tanks withdrew to defiladed positions while the next attack was planned. The next attack jumped off at 1300 and continued to objective 12. The infantry followed and cleaned out Fontenaille. By 1500 the tanks were on objective 13, and, at 1600, infantry supported by tanks moved through the tank battalion to Taverneux and started organizing the position overlooking the Ourth River and Houffalize. At 1800, just after dark, the tank battalion was relieved and started moving back to the assembly area in Pisserotte. By 2100, all elements were closed in the assembly area where gasoline, oil and hot food were available. By 2300, fighting crews were in bed, and the battalion was ready for another mission.

The above example should illustrate some of the possibilities for use of the tank battalion by the infantry division. In this case the tank battalion and infantry battalion had never worked together before. However, the attack was extremely successful from both the tank and the infantry points of view. It was successful because: the terrain was suitable for a tank attack while an advance across the open ground would have been costly to the infantry; the tank missions and the infantry missions were assigned by a higher commander, and the tank and the infantry commanders were held responsible for executing them; time was allowed for coordination, and

tanks were not required to jump off in the dark without knowing where they were going or why.

In summary, the infantry division commander should remember that there are two types of tank missions, and that each requires specialized training. The accompanying or direct support mission can best be performed by the tanks organic to the regiments. These tanks should always be with the assault echelons of their parent regiment, giving direct fire support and furnishing antitank protection. They should not be formed in mass as companies or as a provisional battalion to lead an attack. The tank battalion should be used to perform the assault mission. This battalion is a powerful, mobile, offensive weapon which should be employed *as a unit*, and should not be parceled out to reinforce the accompanying tank support. On defense, it should be required to thicken and deepen the antitank defense of the division with the major portion of its strength held in reserve prepared to counterattack. In the offense, it should be held in readiness so that when conditions are suitable it can be employed in mass on decisive missions.

We have learned by hard experience that the Nation's security establishment is, in fact, a single fighting team composed of three services each supplementing the other in proper balance. It must mean that it is now necessary to so organize that we can obtain a well-rounded annual program. The need is for efficiency, economy, simultaneous overall consideration of the requirements and the maximum pooling of talent. What is required of us in war we must prepare to do in peace.

General of the Army Dwight D. Eisenhower

Hospitalization and Disposition of PW Patients In The United States

Lieutenant Colonel James T. McGibony, *Medical Corps*

DURING World War II the hospitalization and evacuation of enemy prisoner of war patients arriving in the United States presented new problems for the Medical Department of the Army. In order to solve some of these problems as expeditiously as possible, a liaison officer from The Surgeon General's Office was placed on duty with the Provost Marshal General, who was responsible that adequate security measures were taken for the proper handling of all enemy prisoners of war in this country whether able-bodied or patients.

The flow of prisoners of war to the Zone of Interior began in May 1942. Prisoner of war patients were transported to the United States in army transports or hospital ships, depending upon the degree of the illness or injuries. In the first few movements, the number of sick and wounded arriving was comparatively small, and they were sent, along with able-bodied prisoners, to designated prisoner of war camps. The Medical Department, by War Department Circular 214 dated September 1943, extended the facilities of certain port hospitals for the reception, processing and treatment of prisoners of war arriving from overseas, and extended the facilities of general hospitals in certain service commands for the treatment and care of prisoners. As more and more sick and wounded prisoners arrived, it became apparent that a more definite policy had to be formulated for their reception, processing, care and treatment. Consecutive movements of prisoners of war not only brought increased numbers of patients, but also those with very severe war wounds, and it was soon evident that the ordinary station hospital could not handle such cases, and it was doubtful whether the general hospitals in the country could handle them in addition to the large number of American patients returning.

Under the provisions of Prisoner of War Circular No. 11, 8 February 1944, which replaced War Department Circular 214, as prisoner of war patients arrived at a port, they were transferred to a general hospital designated for reception of patients from that port. At this port hospital the patients were processed, and those who were transportable were sent to hospitals at, or adjacent to, appropriate prisoner of war camps for further treatment. Lovell General Hospital, Ayer, Massachusetts, was used for Halifax and Boston ports of debarkation. Halloran General Hospital became the receiving hospital for the port of New York, while Stark General Hospital was designated for the reception of prisoner of war patients from Hampton Roads and Charleston. Letterman General Hospital served the Port of San Francisco. The Station Hospital, Florence, Arizona, was designated for the reception of prisoner of war

patients suffering from pulmonary tuberculosis, while Mason General Hospital received the neuropsychiatric cases. The blind were sent to Valley Forge General Hospital. Processing, examining and treating these prisoner of war patients, together with the security measures necessary, such as guards, wire inclosures, photographic teams and fingerprinting units, made speedy evacuation rather difficult. Hospitals became crowded with prisoner of war patients presenting a very difficult security problem.

POW Circular No. 11 established a policy whereby prisoner of war patients were concentrated, insofar as possible, in one general hospital in each service command rather than having them scattered throughout the United States in general hospitals, and burdening these installations with problems peculiar to prisoners of war, such as providing separate ward facilities, segregating different nationalities, providing separate messes, and enforcing complex prisoner of war administrative problems. For example, in the First Service Command, the facilities at Lovell General Hospital were extended to prisoners of war. In the Second Service Command, Halloran General Hospital, Staten Island, New York, was designated, and so on throughout the Service Command.

POW Circular No. 11 also established the War Department policy on the treatment of prisoners of war, by providing that they were to be furnished with the same medical and surgical treatment accorded United States military personnel. Article I, Chapter 1, of the Geneva Red Cross Convention, July 1929, gives, in broad terms, the basic concept underlying the policy adopted in the care and treatment of sick and wounded prisoners of war. It states, "Officers, soldiers, and other persons, officially attached to armies, who are wounded and sick shall be respected and protected under all circumstances. They shall be humanely treated and cared for without distinction of nationality by the belligerent in whose power they fall."

With the expansion of operations in Italy and France, efforts were made to retain German prisoner patients in overseas theaters. This was found necessary because the influx of U.S. casualties to the Zone of Interior was increasing rapidly and hospital beds in general hospitals had to be used for United States military personnel. However, overseas commanders informed the War Department that they did not have the facilities nor the personnel to care adequately for enemy sick and wounded. Based upon the information that large shipments of prisoner of war patients were to be received within the Zone of Interior, steps were taken immediately for the designation of Glennan General Hospital, Okmulgee, Oklahoma, for the receipt, screening and care of German prisoner of war patients exclusively. With the exception of the commanding officer and a few other key personnel, Glennan was staffed with German medical officers and enlisted men. This was accomplished in July 1944. In addition to Glennan General Hospital, beds at certain station hospitals surrounding Glennan were made available for prisoner patients not requiring definitive treatment.

It was soon evident that Glennan could not handle the entire load, and the War Department was requested by The Surgeon General to make additional prisoner of war general hospitals available. As a result, the Camp Forrest Station Hospital was established as a general hospital for prisoner of war patients.

German prisoner of war patients arriving from overseas were sent to the port hospital where they were processed with the least practicable delay, usually not exceeding seventy-two hours. Transportable patients were then sent to Glennan

General Hospital where they were given a complete physical examination, the less serious cases being sent to the station hospitals surrounding Glennan.

A few months prior to VE-day information was received that obviously repatriable German prisoner patients would no longer be sent to the Zone of Interior, and that the influx of other sick and wounded would be greatly reduced. Following receipt of this information, it was decided that it would be more economical to collect all German prisoner patients in need of definitive treatment in one, instead of two, general hospitals. In June 1945, therefore, Glennan General Hospital was deactivated, and the 1,143 German patients remaining there were transferred to Forrest. Glennan General Hospital and the hospital at Camp Forrest were not only the first general hospitals in the United States designated exclusively for German prisoner patients, but they were also the first U.S. hospitals to be almost completely staffed by enemy medical personnel (protected personnel).

Article IX of the Red Cross Convention, 27 July 1929, states: "Personnel charged exclusively with the removal, transportation and treatment of the sick and wounded, as well as with the administration of sanitary formations and establishments, and chaplains attached to armies, shall be respected and protected under all circumstances. If they fall into the hands of the enemy, they shall not be treated as prisoners of war." It was this protected personnel that was used to staff the German PW hospitals. With the exception of the commanding officers, chiefs of services, executive officers, and key personnel, these hospitals were staffed with German medical officers and enlisted medical personnel, who were carefully screened to determine their professional qualifications and cooperation. United States medical officers, possessing a thorough knowledge of the German language, visited all German prisoner of war camps and personally interviewed prisoner of war personnel claiming protected status. German medical personnel certified as protected personnel were assigned to medical installations for the treatment of their own nationals.

Article 69 of the Prisoner of War Convention of 1929 reads as follows: "Upon the outbreak of hostilities belligerents shall come to an agreement to name mixed medical commissions. These commissions shall be composed of three members, two of them belonging to a neutral country, and one appointed by the detaining power. One of the physicians of the neutral country shall preside. These mixed medical commissions shall proceed to the examination of sick or wounded prisoners and shall make all due decisions regarding them. Decisions of these commissions shall be by majority and carried out with the least possible delay."

It was apparent that the selection of repatriates was a medical function and the responsibility of unbiased medical personnel, but the cooperation and assistance of the Provost Marshal General was necessary, and of paramount importance. By coordinating the combined efforts of the Surgeon General and the Provost Marshal General, a mixed medical commission was activated in November 1943 to examine sick and wounded German prisoners to determine their eligibility for repatriation. Visits were made to the various prisoner of war camps by members of the mixed medical commission, and arrangements were made for the repatriation of those cases authorized by the commission. From the activation of the mixed medical commission in 1943 until its deactivation in 1945, approximately 8,000 German prisoners were examined. Of this number over 1,000 were found eligible for direct repatriation which was accomplished. In addition to patients found eligible for repatriation by the mixed

medical commission, authority was given to certain general hospitals to certify for direct repatriation all German patients who were obviously eligible.

After VE-day, in planning the return of German prisoners of war to Europe, the repatriation of the sick and wounded, and those physically unable to do a full day's work, received top priority. In order to keep currently informed of the number of prisoner patients remaining in the United States, so that necessary arrangements could be made for their repatriation, directives were sent to all service commands requesting them to send to the hospital at Camp Forrest all German prisoner patients who were permanently disabled or physically unable to do a full day's work, or who required hospitalization for sixty days or more. After the deactivation of Camp Forrest in April 1946, the respective service commands were requested to retain within their command all patients previously sent to Camp Forrest. The service commands were further instructed to designate collecting points in their commands for prisoner of war patients eligible for repatriation. Repatriation movements of sick and wounded occurred on the average of one per month, depending upon transportation facilities. After VE-day, approximately 30,000 German prisoner of war patients were returned to Europe. The seriously sick and wounded were sent back on hospital ships, the others on troop transports. Each movement had a proportionate number of enemy protected personnel to assist in the care of their own nationals en route.

No great problem ever existed in reference to Japanese prisoner of war patients. The Station Hospital at Camp McCoy, Wisconsin, was designated for the hospitalization of Japanese prisoner patients, and in November 1945, approximately 700 Japanese patients were repatriated to Japan. The repatriation of sick and wounded Italian prisoner of war patients was a slow and tedious affair. Due to the ill-defined status of Italy as a co-belligerent and since only Italian prisoner of war patients residing in allied occupied territory could be returned, rapid repatriation was practically impossible. Shortly after VE-day, restrictions were lifted, however, and approximately 2,000 Italian prisoner patients were returned to Italy.

Summary

1. The hospitalization, evacuation and disposition of prisoner of war patients in the United States was based upon the Geneva Prisoner of War Convention and the Geneva Red Cross Convention, both dated 27 July, 1929.

2. It was the policy of the War Department that prisoner of war patients in custody of the United States receive the same treatment and care accorded American patients within this country.

3. An effort was made to utilize protected personnel in the care of enemy prisoner of war patients, which was quite successful and permitted release of American personnel for other duty.

4. The hospitalization, evacuation and disposition of prisoner of war patients was handled, insofar as possible, along similar lines as that for American patients, but was, of necessity, closely coordinated with the Office of the Provost Marshal General, inasmuch as these patients were still prisoners, and policies of the Surgeon General had to fit into the security pattern and not conflict with the regulations of the Provost Marshal General. This coordination was carried out by designation of a liaison officer from the Surgeon General's Office in the Office of the Provost Marshal General, which resulted in smooth, coordinated action.

MILITARY NOTES AROUND THE WORLD

AUSTRALIA

Experimental Rocket Range

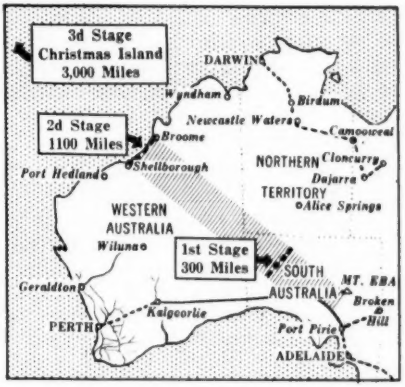
Plans for the construction of a 3,000 mile rocket range have been officially announced in Australia.

The range head will be near Mt. Eba (South Australia). Rockets will be fired in a northwesterly direction and will ultimately cross the Western Australian coast between Shellborough and Broome in the direction of Christmas Island in the Indian Ocean.

The range is expected to cost about $20,000,000. The Salisbury munitions factory near Adelaide is being retained to assemble components of rockets, or eventually for their manufacture. Construction of the first section of the range, about 300 miles, will begin soon after the arrival in Australia of the Rocket Mission. Subsequently, the range will be increased in length until rockets will be fired a distance of 1,100 miles within the Australian mainland.

Thereafter, as experiments proceed, the range will be increased until finally rockets will be fired 3,000 miles in the direction of Christmas Island. The initial 300-mile stage is wholly in South Australia and includes only a very small corner of the aboriginal reserve.

It is planned to make the range 200 miles wide, but in practice only the center line of this strip will be in use. At the point between Shellborough and Broome, on the Western Australian coast,



where the rockets will cross, settlement does not extend far inland. The range interferes less with white settlement or with the aborigines in their reserve than any other possible range.

The project has been called the Guided Projectile and Supersonic Pilotless Aircraft Project. The question of experiments with supersonic aircraft will be gone into after the experiments with rockets are under way.

The construction of a new railway, at a cost of nearly $3,000,000, and a gigantic water scheme, will be involved in the establishment of the rocket range. The undertaking will also involve the creation of a complete new township to accommodate 500 workers and their families.

(*Australia*)

JAPAN

Electric Mortar

Investigation of a secret laboratory and gun emplacements on the coast, six miles south of Yokosuka indicates the probability that the Japanese had developed an electric mortar of extremely high power.

Although some equipment had been destroyed, the Japanese failed to blow up the gun barrel, electric coils, generators and transformers which could be reconstructed into a complete assembly. The gun had a fixed emplacement in concrete and a ramp forty-five feet long at a 45-degree angle, presumably for the highest possible trajectory.

The barrel was lightly constructed of alternating steel and wood, and could be fitted with an interior lining of electric coils capable of carrying high current.

Within the coils was believed to be a sleeve or casing to carry the projectile, which was impelled by a current from the breech to the muzzle, stepping up the speed until it reached a high muzzle velocity.

Such a gun would not require a large explosive charge and would not have muzzle flash, smoke or initial sound, thus affording greater concealment. It would not be necessary to store large quantities of high explosives nearby. But a tremendous amount of electric current would have been needed.

A six-foot working model of the gun was found in the debris. (*Army Times*)

Outboard Engine

An outboard marine engine, used by the Japanese for propelling heavy barges and pontons for bridges, is an inverted affair; its four cylinders are below the crankshaft. This gives it a lower center of gravity and makes it less conspicuous. (*Science News Letter*)

USSR

Moscow Artillery Academy

The Moscow Artillery Academy, which is credited with contributing greatly to the development of the Russian army artillery during World War II, has been in existence for more than 100 years. Only personnel with a high school education, and who have served three years

in an artillery unit may enter the academy, from which Red Army officers graduate as first-class gunners. In this picture, Russian Army officers are studying fire-direction instruments, of which the school has both foreign and home-designed types. (*Illustrated London News*)

INDIA

Army Educational Corps

Responsibility for the educational training of troops in the post-war Indian Army is to be placed in the hands of a new corps —the Indian Army Educational Corps.

The duties of the Corps will include training instructors and instructing men in subjects in unit and station classes.

Previously, this training rested with the Army Educational Corps (British). A number of Viceroy's Commissioned Officers (VCOs) were attached. During the war, the Corps was reinforced by Indian Commissioned Officers and VCOs. (*Indian Information*)

SWEDEN

Underground Factory in Sweden

While AAF's industrial planning officers are studying a report on underground factories in Germany and considering this type of establishment in the United States, several unexpected advantages of buried installations are reported from Sweden where key industrial plants were put underground during the war.

With no windows, weather-resisting walls and roofs, or fences to maintain and repair, maintenance costs are low. Heat is seldom necessary, even in Sweden, as the building is so far below the surface that the temperature is constant. Fire protection costs are low as, when the workers have been evacuated from a section of the plant, the air intakes can be closed and the fire smothered.

Probably the most important point, from a productivity view, is that the workers do not object to working in a plant underground. Some prefer it to an above-ground plant, others claim it is more healthful, and tests have indicated that eyesight actually has benefitted.

Construction costs for an underground plant are estimated to be about fifteen per cent greater than for a conventional factory because of the necessary excavation. But operators of the Bolinder-Munktell airplane engine company, located in central Sweden and carved out of solid rock, state that construction costs are very much dependent upon the quality of the rock in which the excavation is made.

With granite rock, no bracing is necessary. The building itself is constructed of beaverboard on a wood frame, and with parquet floors. Two air inlets are cut through to the top of the hill under which the plant lies, and air conditioning equipment controls humidity and temperature. (*Aviation News*)

PANAMA

Defense of Panama Canal

Details of defense plans for the protection of the Panama Canal have been the subject of recent conferences between Panama and the United States.

By treaty in 1936, both Panama and the United States accepted joint responsibility for defense of the canal. During World War II, Panama granted temporary use of 130 sites in the Republic. How many of these continue to be necessary for defense of the canal is the subject of the recent negotiations.

Of the 130 defense sites, the majority have already been returned to Panama. Only thirty-six are still occupied by the United States Army. These include twenty-three small sites in remote places where troop detachments are stationed, three sites on islands formerly uninhabited, and ten landing fields. (*New York Times*)

CANADA

Collaboration with United States

In joint announcements from Ottawa and Washington, the governments of Canada and the United States recently proclaimed a continued policy of collaboration for the military security of North America.

The five-point program includes agreements on unification of training, standardization of arms, and mutual use of military, naval and air facilities. Both governments stressed that the charter of the United Nations remains the cornerstone of their foreign policies.

Since 1940, the two governments have unified their common military problems through a permanent joint board on defense. This group will continue the work on the following principles:

1. Interchange of selected individuals so as to increase the familiarity of each country's defense establishment with that of the other country.

2. General cooperation and exchange of observers in connection with exercises and with the development and tests of material of common interest.

3. Encouragement of common designs and standards in arms, equipment, organization, methods of training and new developments.

4. Mutual and reciprocal availability of military, naval and air facilities in each country, this principle to be applied as may be agreed in specific instances. Reciprocally each country will continue to provide with a minimum of formality for the transit through its territory and its territorial waters of military aircraft and public vessels of the other country.

5. As an underlying principle all cooperative arrangements will be without impairment of the control of either country over all activities in its territory. (News reports)

GREAT BRITAIN

Sea-Mine Detonating Craft

Among the many strange crafts designed for the Royal Navy during World War II are fourteen sea-mine detonating vessels, known as "egg crates." The vessels are being scrapped. They were manufactured in the United States during the latter part of the war to detonate a special type of sea-mine used by the Germans. The "egg crates" are 120 X 60 feet, with a 22-foot draught, but when afloat only

two feet of their cumbersome bulk appears above water. They are of welded construction, with water-tight bulkheads to give buoyancy, and open compartments to allow free access to the sea. The vessels created tremendous underwater disturbance over a considerable area as they were towed along by tug-boats. (*Illustrated London News*)

NORWAY

Atom-Resisting Plant

What is described as the world's first atom-proof factory is being built at Rjukan, Norway, by a company which manufactures saltpeter and heavy water.

Many leading Norwegian engineers are working on the construction of the enormous underground plant, which is expected to be completed in two years at a cost of $14,000,000. The plant is said to be able to resist every type of bomb so far invented. (*New York Times*)

GERMANY

Scrapping of German Fleet

The German high-seas fleet was ordered scrapped by Hitler early in 1943, according to documents obtained by the British Defense Ministry from interrogation of officials of the German Naval Staff.

The report relates how Hitler became increasingly impatient with the inaction of his navy's battleships and cruisers, and following an unsuccessful attack on an allied convoy to Murmansk in December 1942, he ordered them scrapped.

As a result, Grand Admiral Raeder resigned and Grand Admiral Doenitz replaced him. Thenceforth, emphasis was placed on submarines, particularly on the new long-range vessels equipped with the *Schnorkel* breathing device.

After the de-commissioning order, the German Navy saved its big warships by various pretexts, but only one, the *Scharnhorst*, ever ventured onto the high seas again, and it was sunk off Norway. (News reports)

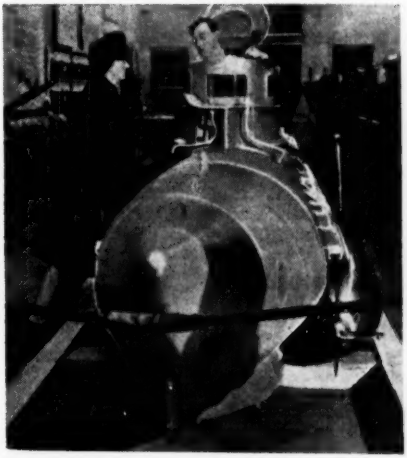
Two German Jet Planes

Focke-Wulf II.

Two jet planes developed in Germany before the end of the war are pictured here. The Focke-Wulf II is a twin-jet swept-back mid-wing cantilever monoplane, for night and bad-weather fighting. It has a single-seat, pressurized cabin, and emergency ejection seat. Armament includes four 30-mm cannon in the nose, and two for oblique upward firing. Construction materials are not indicated. The Messerschmitt P-1110 is a single-jet with the same seat, cabin and emergency features. It is a low-wing cantilever monoplane, for bad weather fighting. Its armament includes only four 30-mm cannon in the nose. Wood and metal were used in construction. (*The Aeroplane*)

Messerschmitt P-1110.

One-Man Submarine



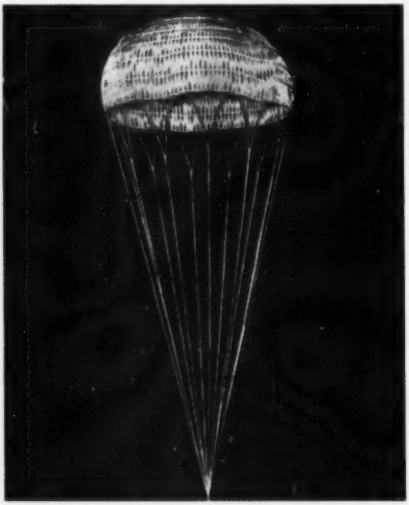
The German *biber* (beaver) carried two 21-inch torpedoes, had a speed of 6½ knots, a length of 29 feet 4 inches, and could dive 150 feet. (*Illustrated London News*)

UNITED STATES

Parachute Recovery from V-2

Successful recovery of valuable instruments from the war-head of a V-2 rocket at a height of sixty-eight miles has rewarded the efforts of researchers at the White Sands (New Mexico) Guided Missiles Proving Ground.

Using two ribbon parachutes, a small container from the one-ton warhead was fired from the rocket and was lowered so gently that the descent required fifty minutes. Previously it had been thought that parachutes could not be used higher

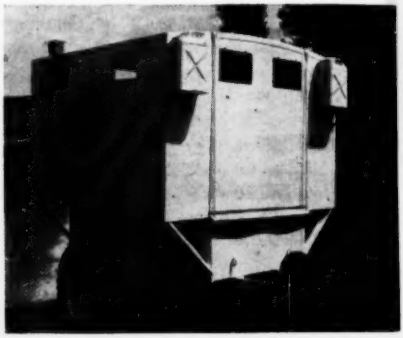


than 150,000 feet because friction would cause them to burn. The ribbon parachutes were developed by the AAF.

At the zenith of the rocket flight, an explosive blew off the rocket nose, releasing the instrument container. A parachute eight feet in diameter opened and lowered the container to about twenty-eight miles. There a second parachute fourteen feet in diameter opened, dropping the container the rest of the distance. (*Army and Navy Bulletin* and news reports)

Mobile Kitchens

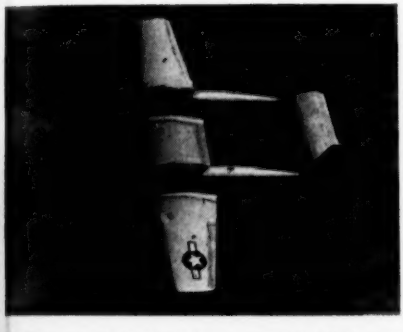
Five types of sheltered mobile kitchens for use in Arctic regions have been developed by OQMG for experimentation, and 27 were manufactured for tests in Operations Frigid, Frost and Williwaw.



The wide type kitchen is made to fit into a standard one-ton cargo trailer. Walls are plywood with celotex insulation. Windows are double plexiglass. The kitchens are painted white inside for cleanliness, and outside for camouflage.

Equipment includes built-in cabinets, small detachment cooking outfit, heater to melt ice and snow, and gasoline lanterns. (*The Quartermaster Review*)

P-82, Twin Mustang



The speed and endurance of AAF's new "Twin Mustang" P-82 was demonstrated on 28 February when the fighter made the 4,978-mile non-stop trip from Honolulu to New York in fourteen hours, thirty-three minutes.

Constructed by joining two P-51 fuselages to a single wing, the P-82 has a top speed of 475 miles per hour, wing span of 51 feet 3 inches, and a length of 38 feet 1 inch. It carries two pilots, and is equipped with automatic pilot and new pulsating seats. (AAF photo and news reports)

Four-jet Bomber

The XB-46 is the AAF's new four-jet medium bomber built by Consolidated Vultee. It is powered by four turbo-jet engines, two in each nacelle. Wing span is 113 feet, length 105 feet 9 inches. (AAF photo)

Miscellaneous

Signal equipment valued at six and a half billion dollars was bought by the Army during World War II, representing a 1500-fold increase over peacetime procurement. This record climaxed two decades of planning for such an emergency. (*Signals*)

An *orthopedic shoe* for convalescents is a new development of Quartermaster Corps research scientists in cooperation with industry. The war-born development now playing an important peacetime role, is adjustable to provide relief for many types of injured and post-operative feet through mechanical provisions for expansion and contraction. (*The Quartermaster Review*)

The supersonic wind tunnel used by the Germans to test V-1 and V-2 rocket models is being installed in the Navy ordnance laboratory at White Oaks, Maryland. Permitting test speeds up to 3,600 miles an hour, the German tunnel reverses the usual functioning by drawing air across the model instead of blowing it by means of fans. (News reports)

Automatic plane landings by means of the GCA (ground-controlled approach) system hooked in to mechanical pilots is a goal during the coming year of AAF experiments being conducted on the West Coast. In this development, the "drone" control of airplanes with visual contact is replaced with radar. (*New York Times*)

A new world record for helicopters was set 10 February 1947 when Major Ernest M. Cassell, chief of the helicopter section at Wright Field attained an altitude of 19,000 feet. The record was made in a Sikorsky R5A. (News reports)

The XF2R-1, a Navy fighter of the Ryan Fireball series, with a gas turbine for propeller and a jet tail boost, has been rated in the 500-mile-an-hour class after successful flight tests. It is the first naval aircraft to utilize the gas turbine. (*New York Times*)

Cold weather operations on opposite sides of the earth have been occupying Army and Navy forces for several months past. Task Force "Frigid," operating in the vicinity of Fairbanks, Alaska, attempted to find out if troops can live and fight in extreme temperatures, and if the equipment of modern armies can function. Three hundred eighty different items of ground and air equipment were tested. Besides providing valuable military information, the tests are expected to have civilian advantages, such as improvements in vehicles operated in northern areas of the United States. In the Aleutians, Task Force "Williwaw" carried on similar tests on Adak Island. Here, in the variable wet-cold climate, men, clothing, and equipment were being carefully observed and tactical exercises carried out. Other cold weather tests were conducted by Task Force "Frost" at Camp McCoy, Wisconsin. At the same time, on the under side of the earth in the Antarctic, the Navy ranged over a vast expanse of the continent and seas adjacent to it. The Navy project not only was intended to enlarge the geographical knowledge of the Antarctic, but to give its personnel experience in polar work and ice navigation. Aerial mapping was one of the major objectives of the expedition, the work being accomplished by far-ranging planes from each of the three groups into which the main task force was split. Preliminary reports from the expedition indicated that some major changes in the map of the Antarctic coastline will result from this exploration; hitherto unknown areas, mountain ranges, vast seas, and two ice-free areas in the interior have been located. Rear Admiral Richard E. Byrd again flew over the South Pole. A hard-surfaced airfield on the continental ice-cap to handle all types of planes using standard landing gear was among the projects of the expedition. (News reports)

An artificial eye developed by the Army from plastic has been used by more than 7,500 former soldiers in the past three years and has been adopted by the Veterans Administration. The plastic eye was developed after the outbreak of World War II when the supply of glass eyes, previously mainly German-made, became depleted due to breakage and difficulty of replacement. (*Army and Navy Register*)

A new electronic calculator, called the EDVAC (electronic discrete variable computer), is being constructed at the University of Pennsylvania for the ordnance department. Described as superior to the ENIAC, a wartime invention which reduced the time needed to solve intricate mathematical problems, the new machine will be installed at the Aberdeen Proving Ground when completed. (News reports)

Eighty colleges, universities, and other agencies are collaborating with the Quartermaster Corps in an intensive food research program designed to improve the rations of the Army. (*Bulletin of the U.S. Army Medical Department*)

A pulsating seat, to relieve "compression fatigue" which develops when airmen sit for protracted periods without a change of position, has been developed by the Personal Equipment Laboratory at Wright Field. A small motor provides the pulses which change the pressure in rubber cells within the cushion and pad of the seat. (*Army and Navy Bulletin*)

Forty-three years after the first successful powered aircraft flight, the wind tunnel balances which actually made the flight possible were discovered recently at Dayton, Ohio, by Orville Wright. With this home-made equipment in 1901, two years before the first successful powered flight, the two Wright brothers were able to solve the mystery of air pressure forces on wing surfaces. (*New York Times*)

FOREIGN MILITARY DIGESTS

Was Our Pre-War Training Wrong?

Digested by the MILITARY REVIEW from an article by Lieutenant Colonel W. H. Huelin in "The Journal of the United Service Institution of India" October 1946.

LET us obtain a clear and correct picture of the case by examining how and where our fighting forces did exactly receive their training in the past.

The British Regular Army and Territorial Force were trained chiefly for a war on the continent of Europe, a good deal of attention being given to combined operations, a somewhat special subject. Moreover, as the army was working on the Cardwell System, many regular units had experience training in different parts of the Empire, but mostly in India, thereby, as will be clarified later, receiving training in a tropical climate and in varying terrain, in most cases quite different from that found on the European continent.

The Dominion and Colonial Forces, in which are included those of Canada, New Zealand and Africa, carried out training in terrains peculiar to their respective countries. These were of varied natures, and that training carried out by our colonial forces of East and West Africa was especially so—namely, jungle warfare; and from there, came leaders and many men to help us fight the Japanese in the jungles of East Asia.

The army in India had been trained in, and had experienced warfare of widely different kinds. These units employed on the northwest frontier had had such training, and some fighting there. Many units of the Indian Army considered themselves specialists in frontier warfare; and well they might. There also existed an eastern frontier force and a Burma defense force, trained for, and experienced in fighting in the jungle tracts to be found in India's eastern borderlands.

The last of the British land forces to be considered are those units of the British and Indian Armies that were scattered in the more out-of-the way parts of the Empire; Malta, Egypt, Aden, Singapore, China, Burma and a few other places. In some, there may not have been sufficient troops to carry out training at levels above that of the battalion, but nevertheless, experience in training over divers terrain most certainly has been obtained by those stationed there.

So far, no mention has been made regarding the training of our air forces, but briefly put, our home air force, such as existed, was trained for operations in support of our expeditionary force; while that portion of India often supported our troops operating in the mountainous country of the northwest frontier; and that stationed in Egypt, Aden and Iraq, trained and operated in desert country.

Sufficient has been mentioned above to show that although training in varied terrain has been definitely specialized in,

yet in actual practice, much such training and experience had been gained prior to the outbreak of the present war. It was the presence of other factors that, to a great extent, neutralized the value of that training, and which are to be guarded against in our post-war system if we are to have suitable forces ready for use against potential enemies when and wherever they may in the future appear.

The other factors alluded to were two in number. First, our general national apathy towards the looming war clouds, and secondly, the economic stringency placed on all matters that are required for the building up of a really efficient fighting force. These two factors combined rendered the production of the right type of leaders and men with modern battle equipment well nigh impossible, and resulted in the land and air training of our forces being executed on out-of-date and unsound lines.

It is more than likely that had we been more alive to the world situation and developments in modern armaments, the supposed failings in our pre-war training system would never have appeared at all. Our soldiers and airmen with up-to-date weapons in their hands, and their leader's minds trained to work in proper channels for battle under present conditions, would have done justice to their professions in whatever part of the Empire they might have been called upon to act.

Reports of our intelligence service would have been credited, and sufficient time would have been given to our General Staff to make proper preparations to meet the emergency. No policy or system of training that had our pre-war economic and mental background and outlook could have been reasonably expected to produce troops fit to engage an aggressive, modern, equipped, and trained present-day first-class power, with any hope of success. It would, therefore, be unfair to attach all the blame for our lack of success in the opening phases of the present war to our pre-war training policy and system.

The Lessons to be Learned

Let us examine the experiences of the late war in the different theaters of operations:

Case 1.—The fighting in Poland, Holland, Belgium and France showed us the superiority of well trained modern armored land forces, employed in conjunction with modern, ruthlessly operated air forces and battle-trained minds, over our own and allied troops, still laboring under a last-war mentality and provided with little armor and much out-of-date equipment.

Lesson 1.—Our future land and air forces must be trained and equipped on modern lines.

Case 2.—Norway showed us the futility of committing ill-trained, poorly equipped troops, insufficiently supported from the air, to operations in difficult country against a prepared enemy.

Lesson 2.—Special troops with special equipment are required for operations in country of a particular nature.

Case 3.—The battles in Italian East Africa were won by troops that had received no highly specialized training although perhaps not against a fully determined enemy. They were, however, fought over varying terrain and with weapons with which our pre-war army was normally equipped.

Lesson 3.—Our arms and equipment being approximately equal to that of the enemy, our pre-war trained soldiers and airmen showed that they could produce success in battle.

Case 4.—The initial stages of the North African Campaign gave a similar lesson to the last, but with the entry of the Germans into the African picture, namely, the appearance of properly handled modern equipped and trained forces, a change

of fortune was produced, and we were soon with our backs to the wall at El Alamein.

Lesson 4.—Superior weapons will often decide the issue in battle.

Case 5.—A reversal of the fortunes of war is next seen in our glorious advance to Tripoli, and the subsequent surrender of the enemy in Tunisia brought about by our battle-hardened troops having at hand ample modern equipment and a powerful air force to support them.

Lesson 5.—Well trained troops with an ample supply of first class weapons and equipment, combined with air superiority over the enemy, will give decisive results.

Case 6.—The defeats we suffered in Hong Kong, Singapore and Malaya were not the results of bad training in the true sense. They were the outcome of the same unpreparedness and irresolution previously mentioned in the opening phases of the war in Europe, where we were, in a like manner, faced by an aggressive, resolute, and fully prepared enemy. The campaign in Burma, with our loss of Rangoon and retreat through the Burmese jungle to India, were also a product of our unpreparedness and indecision and not the results of bad training. In these, however, there came to light a weakness in a particular type of warfare to which we, in pre-war days, had given little serious attention; namely, jungle warfare.

Up to then, our jungle wars had been restricted to fights against a semi-civilized, poorly armed enemy. Of warfare in jungle country against suitably equipped and well trained troops of a modern first class power, few of us had ever dreamed. For this failing, the blame cannot justly be laid against our training policy or soldiers generally, but again, rather to our narrow pre-war national outlook towards military matters. This, and an unsatisfactory political situation, had no doubt brought about a normal depression in the Indian Army which had affected the fighting qualities of our leaders and troops.

Lesson 6.—In this case, adequate troops accustomed to operate in the jungle were not at hand when required, nor was the preparation and organization for defense of areas thickly populated by Asiatics, properly understood.

Case 7.—The operations of our Dominion Troops in New Guinea showed how, when we had brought together resolute and suitably equipped troops with adequate air support, we were able to transform a back-to-the-wall situation, somewhat similar to that at El Alamein, to a brilliant advance over difficult ground through jungle country that culminated in the enemy being driven into the sea as an alternative to surrender.

Lesson 7.—The right kind of properly equipped troops can turn the scales in a campaign.

An altered map of the world will indicate as to where our future battles may have to be fought, and our experiences in the late war should show us what different forms of training will be required in such places. But no matter what carefully planned system of training we may choose to adopt, neither the information gained in the late war, nor any new system of training will be of avail, unless we keep our minds alert to the worldwide varying situations caused by the continual changing mentality of mankind and the improvement and innovations in weapons and machines.

We must resolve to give our fighting forces the best we can produce and also our full moral support, that they may feel that it is on them and their proficiency that we are dependent for our survival when faced with danger.

The System Suggested

Although it has been shown that prior to the late war we did have some parts of our forces trained to fight in particular terrains, our experiences now have brought

out the importance of having very highly specialized troops trained for battle in those particular terrains.

To meet this demand, we must in the future have at least a nucleus of specialists so skilled; experts in combined operations to study the problems involved in landing troops on to hostile shores; experts in jungle warfare to tell us how to combat nature as well as the human enemy in such regions, and also how modern inventions may be best used to assist us there. Our experts in desert warfare will be required to discover the antidotes to the difficulties met with when campaigning in hundreds of miles in sandy wastes in a torrid climate, and how vital blows may be struck there at a less prepared enemy.

May it never be that our future world will necessitate these experts and their deadly instruments being called into action, yet, were it ever so necessary, then we would have at hand the means whereby an aggressive belligerent would be at once checked, and ourselves probably saved from having to shed great quantities of our blood and treasure in fighting out another long war.

As in other professions, so does each special type of military subject need a center where all details affecting that type may be studied by experts. All new ideas and material accessories of the particular type of warfare should be brought to that center for examination and experiment. These centers should take their shape in specialist training schools. Besides a purely teaching side, there will need be a "G" side concerned with keeping the teaching up-to-date with the latest information received on tactics, new weapons and equipment connected with their particular problems.

The following types of schools will emerge:

Mountain Warfare School; Town, Village and Street Fighting School; Desert Warfare School; Coast Attack School; Jungle Warfare School; and Arctic Warfare School.

Such schools should be set up in country where the terrain is correct for the specialized type of warfare as taught in them. Considerable numbers of troops must be stationed nearby who would be recognized as specialists in that particular brand of warfare. These would be armed, equipped and clad according to their roles. They would remain stationed there indefinitely, and should bear designation titles such as:—5(Mtn) Bn. Royal York Regt., 7(Coast Attack) Bn. Royal Lancaster Regt., etc. All officers and many NCOs would be required to pass through their school, and refresher courses would be held.

These schools would give instruction in the details of all the minor operations affecting the main subject taught. For example, the Coast Attack School would instruct in the use of assault craft, the beach organization, the advance and attack on enemy strongpoints, the consolidation and maintenance of positions gained. Troops of all arms would be required to attend.

In the staff of the school, the staffs of the formations in the area would circulate as instructors or experimental specialists, while the formations working in the area would be required to pass on to the school the results of any practical tests carried out by them in training exercises. The teaching of the school would thereby be kept abreast of the latest ideas and be closely knit to what was being carried out in practice.

In the event of a threat of war in any particular theater, GHQ would have at its disposal, through the above organization, a nucleus of troops highly trained and properly equipped for immediate operations in any role in varying terrain, and also the wherewithal for a rapid expansion of any specialist force.

The late war showed the importance of specialized training schools, and it will be argued that certain specialist schools already existed before 1939. The point here advanced is, however, that schools by themselves are inadequate, as they become staffed by personnel who often have a theoretical knowledge only of their special subject, and have a tendency to become academic, theoretical and to expound out-of-date ideas. It is essential that the specialist school be linked up with the troops whose operational role it is concerned with.

The French in the Italian Campaign

Translated and digested by the MILITARY REVIEW from a French article by Captain Bessière in "Revue Historique de l'Armee" (France) July 1946.

MADE up of the large units, general reserve and service elements organized in 1943 under the Anfa (Casablanca) agreements, the French Expeditionary Force (CEF) fought from the beginning of the Italian Campaign as a well-trained instrument of war. Originating in the former French African Army, and augmented by volunteers who came from France by way of Spain, the CEF possessed all the qualities of its predecessor which had fought in Tunisia.

The CEF was composed originally of two divisions (the 2d Moroccan Infantry Division and the 3d Algerian Infantry Division), a general reserve, and service elements. In the spring of 1944, it included also the 4th Moroccan Mountain Division and the 1st Free French Division, three groups of Moroccan cavalry and new general reserve formations. It was a small army. The first elements of the CEF landed in Italy in November 1943.

The Abruzzes Sector

When the Americans and British had taken Naples, the first phase of the Italian Campaign was over. The Allies now possessed airdromes and the port of Naples, and were, therefore, able to bring up the forces to hold the conquered terrain and start the march on Rome.

Between Naples and Rome are high mountains, difficult to cross and rising to a height of more than 6,500 feet. From the south and southeast they present very steep slopes which the Germans used to advantage in their defense. Except for the narrow stretches along the shore, these mountains present only one route of travel, the valley of the Liri. The approach to this corridor is barred by a promontory on which stood the famous abbey of Cassino. The fight for possession of this promontory, which in turn is dominated by Mount Cairo, delayed the Allies until May 1944.

On 11 December 1943, the 2d Moroccan Infantry Division was placed in the center of the Allied position on the right wing of the American Fifth Army, and in contact with the left elements of the British Eighth Army. It was in the midst of the mountains facing the snow-covered summits. Operating at first under the American VI Corps, it seized the Pantano on 17 December, the approaches to Mount Casale on 18 December, and the Mainarde on 28 December.

On 3 January 1944, the 3d Algerian Infantry Division entered the line. The CEF now entirely committed, assumed responsibility for the sector previously held by the American VI Corps. Its mission was to cover the American II Corps attacking toward Cassino, and to reach the San Elia—Atina transverse highway.

The Allied High Command fully expected to gain possession of Cassino, enter the valley of the Liri and march on Rome. It had prepared a landing in the vicinity of Rome with an army corps and by this flanking action, it was hoped to bring about the collapse of the German forces on the peninsula.

The offensive started on 12 January. The CEF first seized Costa San Pietro and Mount Casale, and in the afternoon of the 13th, the Gustav line was pierced. Our troops thus arrived, on the 16th, at San Elia and the Rapido, but were not able to reach San Biagio. Consequently, on 21 January, the attack was resumed on the right to open the Atina highway. The attack met strong German resistance at Mount San Crice and failed. Just as the attack was about to be resumed, the CEF received the mission to cover the attack of the American II Corps on Cassino, and to capture the enemy positions on Belvedere and Abate hill which flanked the defenses of Cassino and the promontory on which the monastery stood.

The Belvedere operation began 25 January, and after ten days of hard fighting, Belvedere and Abate hill were in our hands, and the Gustav line was again pierced. The American II Corps had not succeeded in taking Cassino, and the operation could not be developed. The threat of a breakthrough, however, prevented the enemy from withdrawing forces from the Cassino front to cope with the landing at Anzio, and, therefore, aided considerably in the formation of the Allied beachhead.

After 5 February, the front became stabilized while the Fifth Army, continued its futile attacks on Cassino. The Germans resisted stubbornly and the gateway to the Liri Valley remained closed.

Spring Offensive and March on Rome

During the course of the winter, the frontal attacks on Cassino failed to give the Allied General Staff the results anticipated. They were, however, resumed, broadening the attack front until it extended to the Tyrrhenian sea, and concentrating on this front all the forces of the Fifth and Eighth Armies. The front which extended from Mount Cairo to the Adriatic remained inactive.

The CEF was placed in line on the Garigliano, on the right of the American Fifth Army, and in contact, on the Liri, with the left of the British Eighth Army operating toward Cassino.

The Moroccan 4th Mountain Division, reinforced by cavalry, was made into a mountain corps, and it was planned to push it across the Aurunci mountains as soon as the German lines were broken. Its mission was to reach the Itripico highway and help the Algerian 3d Infantry Division force its way to Esperia, and then attack the rear of the German positions which blocked the valley of the Liri abreast of Pontecorvo.

The operations can be divided into three phases.

1. Breakthrough operations;
2. Push across the Aurunci mountains;
3. Attack the German position (Hitler line) southwest of Pontecorvo, and enter the Pico area with the main body of the CEF.

First Phase

The task was to penetrate the advanced German position in the Ausoni mountains, to cut off the approaches to Ausonia, and to seize the approaches to the deployment areas which were necessary for exploitation of the first successes.

The Germans counted on conducting the fight with the same troops, first in an advanced position, and later in their main defensive position. Our plan was to prevent the withdrawal by the speed of our attack.

The breakthrough was aimed at four imposing heights, Majo, Feuci, Faito and

Agrifoglio, all valuable observation posts of the enemy. For a long time their summits had been free of snow, but few places offered cover for the attackers.

At 2300, 11 May, the attack began. More than 2,000 Allied guns opened fire, and the infantry advanced.

In the center, the Moroccan 2d Infantry Division forced a breakthrough. On the left was a regiment of the Moroccan 4th Mountain Division, and on the right a regiment of the 1st Free French Division. At 1500 on the 13th, Majo fell. The breach had been made.

Second Phase

The intention in the second phase was to make a surprise penetration into the Revole Patrella massif. Since the enemy did not expect such a move, there was a chance to roll up the German right wing.

This action, essentially one of surprise and speed, was prepared with great care. The task included the attack of an uninhabited massif whose resources, even water, were almost nil. Over-confident of the terrain, the Germans had no defense. In their estimation, it was terrain in which there would be no fighting. By 18 May, all objectives had been reached. In the afternoon of the 22d, Pico was taken and Lenola was reached.

To avoid disaster, the Germans withdrew the 26th Panzer Division from Anzio, and the equivalent of two divisions from the inactive Adriatic sector. With this shift, the left of the American Army effected a junction with the Anzio bridgehead, and the fall of Rome became inevitable.

The Germans afterward stated: "We must bear in mind that French troops are able to go anywhere pack mules can go, and there is always the possibility of a deep outflanking maneuver in terrain that is normally regarded as impassable . . . The enemy prepared this attack down to the most minute details."

This phase was truly decisive, a magnificent victory, both in planning and execution.

Third Phase

Pico having been taken, the Algerian 3d Infantry Division turned toward the north and marched on San Giovanni, striking the rear of the Hitler Line which the 1st Free French Division was attacking. At the same time, the Moroccan 2d Infantry Division, which had been committed again, drove toward Rome along the northern edge of the mountains.

The Germans now hastily evacuated the Hitler Line, and fell back in disorder through the upper Liri and the Melfa, pursued by the British Eight Army.

The Allied forces at Anzio, now assumed the offensive and joined with the American II Corps which had advanced rapidly across the Pontin marshes. The CEF pushed the Germans back, and arrived on the Rome plains on 1 June protecting the right flank of the American Fifth Army. On 2 June, the Americans took Valmontone. On the 3d, the Albain mountains were occupied, and on the 4th Rome fell.

From the Tiber to the Arno

After the capture of Rome, the pursuit continued toward Sienne. At the approaches of Lake Trasimène, the Germans attempted to slow the Allied advance, and succeeded in gaining time for the units which had been thrown back to the left bank of the Tiber to effect a movement from east to west. The CEF found itself again faced with strong enemy forces, and during the latter part of June occurred the battles of the Orcia. For nearly a month and a half, the advance continued against the German formations. Followed energetically by our forces the enemy was unable to hold the terrain, and Lake Bolsena was reached.

On 2 July, Sienne was outflanked. It

was the first important Italian city liberated by French elements alone.

Then began the march toward the Arno. It could not be carried to a successful conclusion, as other plans were being made for the CEF. Preparations were already underway for the landing in southern France, and the CEF was withdrawn from the front, reorganized and sent to points of departure in southern Italy. The only French forces remaining in Italy were the Moroccan 2d Infantry Division, the Moroccan 4th Mountain Division and a few other Moroccan troops. There was but a little more fighting for these units, before the command ceased to exist at midnight 22-23 July.

The Engineering Reconstruction of Cyrenaica Between October 1943 and July 1945

Digested by the MILITARY REVIEW from an article by Lieutenant Colonel J. H. Brass in "The Royal Engineers Journal" (Great Britain) December 1946.

AFTER the axis forces had been driven out of Cyrenaica in the winter of 1942-43, a territory was left behind in which almost every engineering installation had been destroyed or demolished, and the majority of buildings in the towns of Benghazi and Tobruk were in ruins.

Much valuable work was done by the Eighth Army Engineers, and in the interim period up to the autumn of 1943, to make the country habitable; but most of this work was temporary. It became apparent that the time had come when temporary measures should give way to more permanent schemes.

The purpose of this article is to describe some of the engineering work done in Cyrenaica by the Royal Engineers between October 1943 and July 1945 to render the country more fit for the occupying troops to live in, and for the eventual return of the civilian population and industry.

Extent of Territory and Nature of Terrain

Cyrenaica is situated on the North Coast of Africa and is bounded by Egypt in the east and Tripolitania in the west. Although it extends several hundred miles inland over arid desert, it may be considered as a narrow coastal strip extending about 600 miles from Bardia in the east to Marble Arch in the west. Outside this coastal strip, there are no surfaced roads or habitation other than the camps of wandering tribes and native villages.

The center of this strip, from Derna to Benghazi is hilly, fertile country, rising to an altitude of 2,000 feet. It is in this area that most of the native population of 180,000 resides.

The eastern and western thirds, i.e., from Bardia to Derna, and from Benghazi to Marble Arch, are desert waste.

Importance of Cyrenaica

With the campaign in Italy progressing steadily and the invasion of Northwest Europe not started, it will be appreciated that Cyrenaica, with its naval and air bases, was a vital link between Egypt and Northwest Africa.

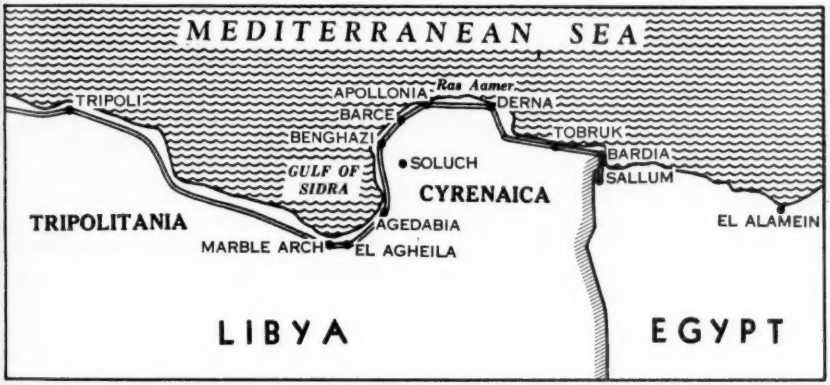
The garrison strength varied from time to time, and in any case is immaterial, but its existence, together with that of the native population, depended on the maintenance of the roads, the provision of water, electric power, and the clearance of ruins and partial rebuilding of the city of Benghazi and the town of Tobruk.

Road Maintenance

Except for two short branches to RAF Stations, and a duplication of ninety miles in the fertile center of the country, there is virtually only one road in Cyrenaica. It runs roughly parallel to the coast, from Egypt to the Tripolitanian frontier. This road is 19½ feet wide, with a tarmacadam surface, and was constructed by the Italians at a cost of 1000 pounds per kilometer. By the winter of 1943-44, disintegration from the heavy traffic of the previous winter was occurring on a large scale. The edges of the road were crumbling, while large, deep pot-holes made traveling slow and dangerous. To restore the road surface to its original condition for its entire length was a matter of importance. Experience had shown that local native labor was not equal to the task, so the following organization was introduced.

Camps of 100 Italian prisoners of war were established at intervals of approximately fifty miles along the road. The two main factors in siting the camps were the proximity of water supply for the personnel, and hard limestone for the road surfacing.

Each camp was equipped with the following items of portable machinery: two stone crushers, two 200-gallon tarpots, two tarmacadam mixers, one 10-ton roller, and six dump trucks. This machinery was set up at suitable quarry sites for the manufacture of tarmacadam and crushed stone from bitumen grouting. This material was run out in the dump trucks where required. In all, some hundreds of thousands of large pot-holes were filled with tarmacadam, and twenty-five miles of road resurfaced with bitumen grouted stone. By the spring of 1945, the whole road surface compared favorably with that of the main roads in England, thus effecting a considerable saving in wear and tear on the vehicles using the road besides safely speeding up their rate of travel.



This road maintenance organization also justified its existence in the spring of 1945, when during a severe gale on 15 February 1945, a large floating dock was wrecked on the rocks of Ras Aamer, the most northerly point of Cyrenaica. The wreck occurred 19½ miles from the nearest road, and could only be reached by donkey and camel train. The problem was to construct a road, in the quickest possible time, to take 10-ton trucks so that the valuable machinery on the dock could be salvaged. A survey revealed that

the proposed road would cross an inaccessible rocky surface and several ravines, three of which were over twenty feet deep with almost vertical sides. A detachment of the road maintenance organization was sent to the nearest town, Apollonia, and equipped with three bulldozers, one mechanical shovel, one grader and eighteen dump trucks. A foundation was made and surfaced with soil that compacted well under traffic. Considerable blasting was necessary in the crossing of the ravines. This 19½ miles of road was constructed in seven weeks.

Water Supply

The Axis forces, on being driven out of Cyrenaica, completely destroyed all water producing installations.

The Benghazi water supply is provided by deep well pumps, and with the return of the native civilian population in 1943-44, it became desirable to increase the water supply there. Trial bores were put down by Royal Engineers to a depth of 150 feet and the yield from these varied considerably. Seven deep well pumps were installed, which gave a total output of 500,000 gallons per day.

In many places, the damaged distribution mains were repaired so that a fairly adequate water supply was provided throughout the city.

Several wells were also sunk in other parts of Cyrenaica and pumping machinery installed to provide a local water supply to our occupying forces and the civilians. The water supply at Tobruk has a salinity of 360 parts per 100,000, and fresh water had to be brought to this town from Egypt by rail. The large distillation plants installed by the Italians at Tobruk had been demolished beyond repair.

Electric Power Supply

The Italian power station at Benghazi was thoroughly demolished by the Axis forces on their retreat, so that neither the building nor the machinery could be used again, although certain parts were salvaged and sent to Tripoli, where they are in use at the power station. Electric power was needed for refrigeration, lighting, workshops, etc., and also for the slowly returning industries of the city.

In 1944, a new power station was built by Royal Engineers and equipped with two 175 kilowatt generating sets. The smaller plants, that had been left behind by the Eighth Army in scattered localities, throughout the city, were brought into the same area as the new sets. This was done because it made for ease and economy in running and maintenance if the sets were all within a confined area and not spread over the city.

A 100 kilowatt plant was installed at Tobruk and one at Barce of 45 kilowatts. In all these places much work was required to renew distribution mains and insulation. The result is an adequate electric power supply for the necessities of the population.

Rebuilding Benghazi and Tobruk

As a result of changing hands five times between 1940 and 1942, the city of Benghazi suffered very considerable damage, and Tobruk, although a smaller town, was reduced to ruins. For sanitary reasons alone, it was desirable to clean up the debris from the ruins and to make habitable all buildings that were not too badly damaged, so that they could be used by the occupying forces, and ultimately the other inhabitants of the country. Many of the damaged buildings were of reinforced concrete. Beams, columns and floors were held together by the steel reinforcement and were hanging at all angles, making their demolition a hazardous procedure. It was found that the cheapest and safest way of dealing with these structures was to attach a small explosive charge to the exposed bars on each item to be demolished and detonate them simultaneously.

A program of reconstruction was decided on in the summer of 1944, and with limited supplies of labor and materials, buildings with an area of approximately 500,000 square feet floor space were made habitable in the ensuing twelve months. The work consisted of plastering and tiling, decorations, the provision of doors and windows, and where possible, electric light, water supply and drainage. Work was started on the top floor of each building and completed floor by floor. Special attention was paid to kitchens, kitchen equipment and hospitals.

General Remarks

In all the engineering projects, consideration had to be given to the labor and material available, and the strictest economy was observed. Benghazi is situated by road over 800 miles from the base (Cairo), so the supply of imported materials was a considerable item. Some projects, for example, the reconstruction of the outer mole at Benghazi Harbor, were not undertaken because of limited material and labor.

Whatever the ultimate fate of Cyrenaica, none of the work done by the Royal Engineers will have been wasted, and it has been a start in the gigantic task that lies ahead in the reconstruction and restoration of installations and property all over the world.

Artillery in River Crossing Operations

Translated and digested by the MILITARY REVIEW from a Russian article by Colonel L. Kurbatov in "Krasnaia Zvezda" (U.S.S.R.) 7 August 1946.

THE planning of artillery action in river crossing operations differs from the usual planning employed in breaching hostile defensive positions due to the presence of a water barrier, and usually by a limited preparatory period. For instance, in forcing the crossing of the western Bug, the planning of artillery support for the crossing troops was effected in the course of the battle and amounted to artillery support of the troops by means of a series of missions combined in a schedule of prepared fires or by verbal orders.

The planning of artillery preparation depends upon the character of hostile defenses and the amount of artillery and ammunition in the possession of the attacker when he reaches the water barrier. If the artillery can neutralize the fires of the enemy, an immediate crossing calls for artillery preparation combined with air attack. When the density of artillery is not sufficient, the artillery preparation may lead to discovery by the enemy and the repulsion of the advance guard and even the assault groups. To avoid this, the crossing can be made under cover of darkness, and the entire artillery should be ready to open fire if the troops are discovered by the enemy.

Artillery fire is planned by periods: (1) Artillery fire during the crossing by the troops, (2) artillery missions during the period of consolidation of the bridgehead, and (3) artillery support of the break-out from the bridgehead. This plan should provide for uninterrupted fires through all the periods.

The duration of artillery preparation varies according to the character of the enemy's position, the amount of time available for the crossing by the advance detachments, the density of artillery in the main attack zone and the amount of ammunition available.

There are no standards for this type of artillery preparation. Its timing

should confuse the enemy as to the time of attack and further intentions of the commander. It should strive for good neutralization and destruction of the hostile position, combined with economy in the use of ammunition. During the period of the initial actual crossing the artillery should deliver a series of very strong concentrations of long duration.

To be successful in an attack combined with the forcing of a crossing, the assault groups and tank units should first break through the defenses on their side of the river and seize a bridgehead on the other side without a pause in the action. The expansion of the bridgehead is effected by the first echelon, while further advance from the bridgehead is done by the main forces of the infantry.

During the period when the troops overcome the hostile defenses on their own side of the river, the battalion and regimental artillery is attached to the assault groups. The division artillery neutralizes and destroys the enemy artillery and manpower, thus clearing the way for the infantry.

With the beginning of the crossing, the entire artillery is switched to support the crossing operation. The timing of the artillery preparation is important. When crossing at night, it should be started when the assault groups land on the other side of the river; if by day, with the beginning of the crossing. The artillery preparation should be brief but powerful. The battalion artillery and part of the regimental artillery cross over with the assault groups.

The division artillery, light artillery, and mortar brigades begin crossing by echelons with the first echelon, but without interfering with the continuity of fires. By this time, the battalion and regimental artillery have crossed and are in support of the assault groups and secure the antitank defense of the bridgehead.

All the artillery to support the bridgehead is, before the crossing and the establishment of observation and command posts, decentralized and attached to small infantry units. This is done because the speed in making decisions is the basic factor of success—here everything depends upon personal initiative and individual action of all artillerymen.

After the seizure of a bridgehead, the general advance begins after a thorough build up of the type usually employed for breaching position defenses. This means building stationary crossings, fortification of the bridgehead, and the regrouping of troops.

In forcing a crossing following an appropriate preparatory period, the artillery support is effected according to the previously developed plan of artillery fires which provides in detail for the support of the troops crossing to the bridgehead, the expansion of the latter, and its consolidation. The main mission of the artillery here is to prevent the enemy from disrupting the crossing, from interfering with the control of the operation, and from blinding the observation posts.

Successful expansion of the bridgehead depends, first of all, upon the amount of artillery attached to the infantry units already on the bridgehead, and the organization of artillery fires on this side of the river. Therefore, as much artillery and mortars as possible should be crossed over with the first echelon. All the artillery crossing with this echelon is subordinated to infantry units and decentralized. It operates with the infantry and in the author's opinion, not less than one-third of the available artillery should reach the opposite side before the crossing of the second echelon.

The heavy artillery, emplaced on this side, is kept centralized until the crossing of the second echelon, and is employed for the neutralization of targets impeding forward movement of the in-

fantry. Artillery may be employed to confuse the enemy by using roving guns in the vicinity of false crossings.

The expansion of the bridgehead should be accompanied by the establishment of antitank defense employing all types of guns. The bridgehead can be held only by a formidable antitank defense. Artillery defense is carried out with close cooperation of all artillery within bridgehead and on our side of the river.

The battle in connection with the forcing of a crossing is a short one. The accomplishment of infantry missions calls for a quick organization of artillery fires in any direction.

The crossing of artillery units is difficult, especially at the time when light artillery brigades and mortar brigades are ready to go over. Crossing equipment at this stage may not be sufficient. Successful crossing of artillery, therefore, calls for the availability and wide use of materials available locally, skillful organization, effective use of military police, correct selection of crossing points, wide initiative and bold and decisive action on the part of commanders and personnel.

The experience of successfully concluded operations suggests this sequence for crossing the artillery. As a rule, the battalion and part of regimental artillery, as well as separate tank-destroyer units, cross with the assault groups. The remainder of the regimental artillery, tank-destroyer and gun units of the division artillery, and one-third of the reinforcing artillery cross with the first echelon. Howitzer batteries of the division artillery and the remainder of the reinforcing artillery (light brigades and mortar brigades) cross with the second echelon.

The heavy artillery begins crossing after the construction of bridges. It crosses at night, after the second echelon. The artillery crosses by echelons. One-third crosses, two-thirds conduct fire. Before the second echelon of the army arrives, if the bridgehead is large enough, all divisions, corps, and self-propelled artillery should be on the other side of the river. The handling of a tremendous amount of artillery calls for careful planning and for adhering to previously worked out schedules of operations.

Air Evacuation of Casualties in Southeast Asia

Digested by the MILITARY REVIEW from an article by Brigadier J. R. Robinson in "Journal of the Royal Army Medical Corps" (Great Britain) October 1946.

THIS article attempts to describe the use and value of aircraft in the evacuation of casualties in the Burma campaign. The facts presented and the conclusions drawn can in no way be attributed to the personal experience of the author. They are written from official reports and from discussions and correspondence with individual officers who had a vast amount of practical experience in air evacuation in Burma.

Historical

In the early days of the Burma campaign, two main factors dictated the organization of medical evacuation. The first was the location of hospitals so as to reduce evacuation to the minimum, and the second was the control of evacuation so that it did not interfere with either the patient's treatment or the work of the hospital to which he was admitted. It was obvious that a patient could not be

cured and moved at the same time.

To meet these requirements, large hospitals were placed as far forward as possible in order to reduce evacuation. The bed capacity of field ambulances * and casualty clearing stations was also increased and light equipment added so that these units functioned as small hospitals for urgent sick and battle casualties. From these beginnings evolved the first light casualty hospital in Southeast Asia, the Indian Malaria Forward Treatment Unit, which fully justified its inception during the campaign.

The siege of Imphal put an end to the policy of placing large hospitals forward and established the necessity for air evacuation. The medical authorities were vividly aware of the advantages to be gained from air evacuation, and pressed the staff from the beginning of the Burma campaign to provide aircraft. Due to their perseverance, aircraft, with certain limitations, were made available and were first used on an organized plan in the Arakan in 1943. From then on, air evacuation became an essential part of the plan of campaign in Burma, because road and rail communications were difficult or non-existent, and the rapid advance of the army frequently necessitated leaving the country behind to revert to enemy hands for considerable periods. Air evacuation was planned in two phases:

Phase 1.—Evacuation from divisional medical units in the most forward areas to the corps medical centers located in the corps area. These divisional units were often under continuous shell and mortar fire, and frequently in range of small arms.

Phase 2.—Evacuation from corps medical centers to advanced base hospitals.

* Field Ambulance (battalion).—One per brigade, two per division. A Field Ambulance is organized into a headquarters and two companies. Each company can furnish one advanced dressing station, and the headquarters can furnish one main dressing station, the latter having a capacity of 100 to 150 casualties.

Evacuation from Divisional Medical Units

Evacuation from divisional medical units was carried out by light aircraft of the following types:

L-5—Known as the "Flying Jeep" (American). This was a two seater high wing airplane with a low landing speed, capable of carrying one sitting casualty. A proportion of these aircraft were modified for carrying one litter casualty each. The stretcher was loaded in the rear cockpit by opening a panel in the fuselage. The patient was normally carried head foremost, but in cases with injuries of the lower limb necessitating the use of the Thomas' splint, the stretcher was loaded head to the rear and the end of the Thomas' splint threaded into the fuselage. This plane was very safe, possessing efficient landing brakes and a range of 100 miles.

L-1—Otherwise known as "Vultee Vigilant." This was a single engine, high wing, light monoplane, with a capacity for one pilot and one sitting case. A certain number were modified to carry one litter case. Certain large editions of this plane were capable of carrying four litter and three sitting, or up to eight sitting cases.

C-64—Known as the "Norseman." This was a single engine, high wing monoplane, carrying four litter and four sitting cases or eight sitting cases.

Tiger Moth—Two seater biplane. Carried one sitting or one litter case in the rear cockpit according to whether or not the aircraft had been modified to deal with the latter. When so modified, the patient was lowered in a special stretcher provided with the aircraft. The patient was unable to see out and required considerable reassurance before emplaning. This plane has no landing brakes, which proved a danger in high speed landings.

Fox Moth—This plane did invaluable service in the Southern Arakan and in the evacuation of West Africans in the Kaladan. It was a single engined biplane flown from the rear cockpit. Forward of

the latter and below was a four seater cabin, capable of carrying four sitting, or one litter case with attendants. It had good landing brakes.

Available Forces and Control.—Two squadrons of U.S. AAF Air Commandos, each composed of thirty-one L-5s and four or five C-64s, were available throughout the campaign, and were allotted on the basis of one squadron per corps.

An additional flight consisting of twelve L-5s and three L-1s of the U.S. AAF was available for part of the campaign, notably during the siege of Meiktila.

In the earlier phase of the campaign, RAF "Moths" were attached to the U.S. AAF Squadron.

A flight of RAF L-5s belonging to 221st Group, RAF, was employed in the evacuation of RAF casualties, and their services were fully and willingly lent to the Army on many occasions.

These light aircraft were controlled by a Squadron Commander, U.S. AAF who worked in close liaison with the corps medical authorities. Aircraft were allotted to "runs" as required and were at the disposal of the medical services. They were based at corps airstrips but flew to divisional airstrips daily from dawn (0600) to about 1600.

As a routine, the last aircraft from any given divisional airstrip brought an estimate of the number of sorties required for the next day. This had the effect of limiting demands for aircraft to emergency requirements only.

Airstrip Required.—A ground strip of 500 yards by 30 yards was necessary to take all types of light aircraft used. Such airstrips were usually constructed by medical personnel of the divisional field ambulance, or by staging sections in accordance with specifications submitted by the Air Force authorities concerned. The location of the strips was signalled by division to the corps. The latter then signalled the squadron. It was usually not difficult to obtain suitable ground, though considerable work was required in removing dikes and clearing undergrowth. The ground was tested after it was cleared by driving a ¾-ton truck over it, and any small mounds were leveled. On occasion, assistance was given by divisional engineers.

Airstrips were marked with white panels, an "L" panel two feet by three feet by one foot being placed at each corner, and white panels six feet by one foot being placed at fifty-yard intervals to mark the external boundaries of the strips. A "T" was placed on the left of the airstrip, half-way along, the long arm pointing towards the approaching aircraft. The factor governing the place of the "T" was tree clearance and not the direction of the prevailing wind.

When the strip was completed, a reconnaissance plane flew over the site in the early morning and photographed the area. If it was considered satisfactory for landing and take-off, the required number of planes flew over immediately. During the Meiktila-Rangoon advance the number of strips constructed was greater than at any other time, and none of the strips was refused by the squadrons.

Inter-communication.—The official channel for liaison between the squadron and the forward medical units was through corps, and personal contact was frequently made between the pilot and the forward troops. Often pilots were able to discuss the suitability of the strips with the officer in charge of construction. The system adopted in the Fourteenth Army in which the squadron worked under corps proved to be more satisfactory than that in which there was direct liaison between the forward area and the rear strip.

Evacuation from Corps Medical Units

Dakota aircraft (C-47) were in the main employed, but on occasions Commandos

(C-46) were also used. The former carried eighteen lying and twelve sitting, or thirty sitting with normal personal kit. The Commandos were larger, and carried twenty-four lying and eight sitting, or thirty-four sitting cases.

Available Forces.—One squadron (24) of Dakota aircraft was employed constantly and solely for the fly-in of reinforcements and the air evacuation of casualties. In addition, a variable number of store-carrying Dakotas and Commando aircraft was available and used for evacuating casualties on their return trips.

The aircraft employed were mixed RAF (Transport Command) and U.S. AAF. The Army link with these authorities was through a Commander, Army Air Transport Organization (CAATO) based at Comilla.

Operational Employment.—These aircraft had to cover the requirements of corps and the line of communication, including districts, areas and sub-areas. Estimates were made by the medical authorities by having the airfields give the number of sorties required for each per day. Estimates covered a fourteen-day working period, and were submitted to the staff of the formation concerned, seven days before the beginning of the fourteen-day period for which they were required. These demands were submitted through staff channels to Army headquarters. The latter submitted a consolidated demand to CAATO which included all formations.

From the estimated bids, CAATO arranged to supply the number of aircraft required by airfields with headquarters, RAF Transport Command, and the AAF.

As a supplement to these fortnightly bids, there was an "SOS" service whereby, in case of emergency, additional aircraft could be made available to any particular airfield or airfields on forty-eight hours' notice. These additional aircraft were demanded for specific days within the fortnightly period, operative at the time of demand.

Because the number of aircraft available was not always equal to the demands made, a system was adopted whereby the formations, airfields, and medical units concerned were notified by signal of the numbers of aircraft available and their estimated time of arrival at each airfield. This signal was made by CAATO on an "Emergency Operations" priority on the evening of the day before the flying of the sorties.

Aircraft were based at either corps airstrips or at airfields in the army area, depending on the terrain and weather conditions. During monsoon periods, alternative routes had to be planned and new airstrips constructed.

The most cordial liaison existed between the Army and RAF authorities to provide the maximum use of available aircraft in all types of weather.

All aircraft used for casualty evacuations were specially fitted to carry stretchers.

None of these aircraft was allotted for the sole purpose of casualty evacuation. They were usually employed on the outward run for carrying reinforcements, supplies and mail. Application was frequently made for ambulance aircraft for medical use only, but this was never permitted, owing to the limited number of aircraft and consequent necessity for rigid economy in the utilization of those available for all purposes.

Airstrip Medical Organization.—Two airstrips were required, the first for the receipt of light aircraft bringing casualties from the forward areas, and the second, the casualty evacuating strip for medium or heavy aircraft for further evacuation to advanced bases.

Both these strips were part of the same airfield, and the unloading and loading sites of both were located as near as possible. An arrangement of this kind

allowed for the minimum use of road movement of casualties and the minimum requirement of ambulance cars. It further permitted one medical unit, under one control, to be responsible for reception, treatment and further evacuation of casualties. It also allowed the simplest liaison to be maintained with airfield authorities.

The medical units on the airstrip were sited at least 400 yards from the strip, to which roads were made. Shade and air were considered, and the dust clouds thrown up by aircraft moving on dirt strips avoided.

The following medical units were employed on these airstrips:—(a) field ambulances; (b) Indian staging sections (combined); (c) casualty air evacuation units (CAEU) RAF.

The employment of field ambulances in these operations tended to immobilize a unit which in battle plans was earmarked for the support of corps troops. The Casualty Air Evacuating Units of the Royal Air Force were well provided with personnel, medical stores and equipment. Since they possessed only British personnel, they were a disadvantage in the Burma Campaign where the bulk of casualties were Indian troops. These units were not available until late in the campaign, and of the total number of casualties, only a minor portion passed through these units. They were never employed forward of corps evacuation centers.

At all these units "triage" of casualties was carried out, i.e., the reception, sorting and classification into those requiring and fit for air evacuation to advanced base hospitals, those for admission to corps medical centers, and those unfit for further evacuation.

The minimum bed capacity was fifty, but was capable of expansion up to 200. All casualties could be held, treated and fed up to two or three days, and those with abdominal wounds, up to ten days.

A minimum of five ambulance cars was considered necessary.

Selection of Casualties for Air Evacuation

The advice of pilots was of considerable assistance in the selection of suitable cases, since flying conditions, such as altitude and "bumpiness," and the availability of oxygen had to be taken into account. With this information, normal clinical judgment was sufficient to insure a correct choice of case. All cases on arrival at the most forward medical units were given first aid treatment, including control and prevention of shock.

It was found that most casualties stood air evacuation well, with the exception of the following cases:—

(a) *Scrub Typhus.*—Scrub typhus cases presented a definite risk, particularly in the first ten days of the disease. Even after short, smooth, low altitude flights, it was found that their condition deteriorated and several died. In most of these, post-mortem examination showed multiple venous thromboses, particularly of the lungs and, less frequently, of the lower limbs. Fortunately, the incidence of scrub typhus fell progressively after the end of the monsoon, and as the campaign progressed.

(b) *Eye Injuries.*—Interocular lesions were liable to further damage by flying at high altitudes and/or in "bumpy" conditions.

(c) *Chest Cases.* — Few pneumonia pleural effusions, or lung abscesses required evacuation, but those evacuated stood the journey well if suitable weather conditions were selected. Those with perforating wounds of the chest, with partial or complete collapse of a lobe were, however, definitely a bad risk and were retained on the ground as long as possible.

(d) *Ear Cases.*—Acute suppurative conditions of the middle ear and their in-

ternal ear complications sustained a definite risk of aggravation.

(e) *Anemia Cases.*—Cases of anemia traveled badly and were held till their hemoglobin level was above fifty per cent.

Aircraft Requirements

In the Arakan, during February 1944, the following air evacuation took place: by light aircraft from forward airstrips, 637; by medium aircraft (C-47) from Bawli/Ramu area to Comilla, 765.

The force operating was four divisions, each with a strength of about 20,000. In the period 30 January to 26 February, their estimated total casualties were 1,913, of which 998 were wounded, giving a percentage per month: wounded, 1¼ per cent; total casualties two and thirty-nine hundreds per cent (including killed, wounded, sick and missing).

Thus, in a total of approximately 1,000 casualties, more than 600 were transported by light aircraft, which was equivalent to two per 1,000 per day. This figure of 600 included some sick as well as wounded, especially from the 81st West African Division, who were, for awhile, entirely dependent on these light planes.

The conclusion reached was that for a campaign of moderate intensity in a healthy area (sick rate less than three per 1,000 per day), the number of cases which required air lift were as follows: by light aircraft, 0.8 per cent of strength per month; by medium aircraft, 0.95 per cent of strength per month.

As the campaign progressed, fighting had to take place in areas where malaria and typhus were endemic and where sick rates were high. Inexperienced troops suffered heavier casualties from malaria in the early phases of a campaign. This was evident from a consideration of the different rates in divisions fighting at the same time and on the same terrain. Such differences were due to different standards of anti-malaria discipline. This situation increased the number of casualties requiring evacuation by air, and by March 1945, evacuation in the Fourteenth Army by light aircraft had averaged from 1,000 to 1,100 weekly.

Light Aircraft.—As a result of experience, the medical authorities considered that one squadron of light aircraft (32) was necessary for each fighting division operating in Burma where sick rates varied from five to ten per cent, according to the terrain and period of the year. Highest sick rates were recorded in March and July. A daily lift of thirty-six casualties over an average range of fifty miles was required. It was considered that each aircraft should be capable of lifting from one to three casualties and carrying at least one stretcher.

Medium Aircraft.—One squadron capable of lifting forty-eight casualties per day over an average distance of 150 miles was considered necessary.

Conclusion

The air evacuation service was uniformly excellent. The highest degree of cooperation existed between the U.S. AAF and the army medical authorities. A very deep debt of gratitude is owed to the personnel of the U.S. AAF squadrons for their unfailing readiness to undertake any task required of them, and there is no question that many British and Indian soldiers owe their lives and limbs to the courage and endurance of these pilots.

Equally cordial were the relations between the Royal Air Force and army medical authorities, and the same tribute is due to the pilots of the RAF light aircraft.

The main lessons learned from the Burma Campaign concerning casualty air evacuation were:

(a) The absolute necessity of light aircraft being allotted for purely medical purposes and being under the direct control of the army medical administration of the formation.

(b) That the army medical units must staff the forward airstrips. These strips are on field ambulance level, and in the Burma Campaign were constructed often within a few hours of the occupation of the ground by forward troops. Though the duty of manning these strips devolved on field ambulances and staging sections, there is need for either special small mobile evacuation units or the use of the field medical company for these duties. In either case, the essential is that they should be army units and under the strict command of medical administrative officers.

(c) The necessity for a minimum number of ambulance transport aircraft to be devoted to medical purposes only and equipped as hospital planes. Such planes must be staffed by medical personnel and there must be a pool of medical personnel for employment with such aircraft when evacuating.

Thoughts on Cavalry

Translated and digested by the MILITARY REVIEW from an article by Colonel José M. Silveira in "Orientación" (Uruguay) September 1946.

CAVALRY reconnoiters, supports, and fights in cooperation with other arms and in this way fulfills, generally speaking, its traditional role. Although it is true that experience has introduced profound modifications in the methods of fulfilling this role, cavalry has corrected its shortcomings and developed with the other arms.

Aviation and tank units were required to replace the old cavalry arm in order to obtain a decision. This was especially true when the ten Polish cavalry brigades and the five French cavalry divisions, many of them already motorized, were unable to resist the aviation and tank attacks of the Germans. In Russia, however, things were different. In August 1941, some units of the Second German Tank Army advanced towards Rostov, in an attempt to reach the rear of the Soviet troops located to the north and surround them. However, the German units were in turn attacked by two Soviet cavalry detachments which, undertaking a forced march on the night of 1-2 August, attacked the enemy at the end of the second day, near Schumachy, destroying thirty German tanks, fifty trucks transporting infantrymen, and two mortar batteries. This cavalry action forestalled the encirclement and possible withdrawal of the Russian troops as the German High Command had planned.

Of the traditional roles of cavalry, combat was the most important, and this and other operations prove that cavalry is not nullified by aviation and tanks, but that it has its own proper missions in cooperation with the other ground arms. It all depends on adequate cooperation being assured.

This combination is based on the characteristics of cavalry: strategic mobility (radius of action and speed) and tactical mobility (speed, fluidity and elasticity), which in combination with fire power, compatible with these qualities, empower cavalry to fight modern arms and consequently fulfill the following missions:

Prior to Combat: (1) Strategic reconnaissance, (2) Front and flank protection.

During Combat: (1) Flank maneuver, (2) Exploitation of success, (3) Protection of an exposed flank, (4) Stopping a

breakthrough, (5) Delaying action, (6) Counterattack.

After Combat: (1) Pursuit, (2) Protect a withdrawal.

Independently of other arms: (1) Raids into enemy held territory, (2) Elimination of parachutists or airborne troops, (3) Observation and protection of certain frontier sectors.

Some of these missions have lost importance, others have acquired it. Exploitation of success, flanking maneuver, raids into the enemy's rear areas, and delaying action are old stories to the cavalry. There are new ones such as action against parachutists and airborne troops and the support of armor.

So that cavalry can be employed with success against the firepower that we must expect the enemy to have, it should possess (depending on the terrain it is fighting in) units well equipped with machine guns, antitank and antiaircraft weapons, half-tracks and armored vehicles.

It is logical therefore, to want to introduce new ideas into cavalry tactics and provide it with the most perfect, modern equipment, but without expecting to motorize or mechanize all of it, for it will be very difficult for our country to build motors and obtain fuel.

We probably would have to think along similar lines in relation to our roads. Those that exist are generally in poor condition and at certain times of the year cannot be used by any kind of vehicle.

The Gibraltar Tunnels

Digested by the MILITARY REVIEW from an article by Colonel T. W. R. Haycraft in "The Royal Engineers Journal" (Great Britian) December 1946.

Early Work

DURING the Great Siege of 1779-83, a system of tunnels was blasted by sappers on the north face of Gibraltar to enable guns to fire on the Spanish lines. The tunnels lie some fifteen to twenty feet behind the face of the cliff which is almost vertical. There are various levels, some connected by inclines, the top level or upper gallery culminating in an observation post on the top of a pinnacle of rock jutting out from the cliff face at a height of some 1,000 feet above sea level. Approach to the whole system is by way of open trenches and tunnels cut in the rock on the northeast side of the town. These trenches are connected at the different levels by sunken stairways and tunnels.

All these tunnels are beautifully made with arched roofs and neatly trimmed sides. When it is realized that the work was done entirely with hand tools and gunpowder, and under siege conditions, the magnitude of the task accomplished is astonishing. The guns were installed in openings off the main tunnels and run forward to fire through embrasures in the cliff face. Up to the beginning of the recent war, the tunnels were seldom used for any military purpose. The old muzzle-loading cannon remained in place, and certain sections were open to the general public.

During the period between the Great Siege and the end of the last century, various tunnels were made by the sappers in connection with the defenses overlooking the harbor. Some of the work on the north face may have been done during this period also.

Modern Tunneling Prior to 1939

A tunnel was driven through the "Rock"

from Sandy Bay for the Admiralty, for the purpose of bringing stone from their quarries on the east side for construction of the naval dockyard. This tunnel carried a spur of the meter gauge railway serving the dockyard. The tunnel passes through a certain amount of bad rock and sand and is lined with brick over these portions.

Between 1908 and 1911, a tunnel was driven to bring fresh water from catchments on the east side of the "Rock" to three rock cut tanks above the town. Between 1911 and 1939, more and bigger tanks were excavated along the line of the tunnel itself, including a second tunnel immediately under the first for removal of spoil eastwards and distribution of water westwards. Work was still in progress on this tunnel at the beginning of the war.

At various times since about 1890, the Admiralty did a considerable amount of tunneling, the principal works being: (a) extensive magazines in the dockyard area, (b) oil and water storage on the east side of the "Rock," the pipe lines being brought through the dockyard tunnel, and (c) tanks for petrol storage at the west end of the north face.

September 1939 to June 1940

In 1938, a series of air raid shelters was started in the town. The city engineer had organized and trained a very good tunneling department using Gibraltarian labor with a Gibraltarian engineer in charge. This department had been engaged on enlarging the water supply storage. On the outbreak of war, this work was stopped and one unfinished reservoir had a three-story barracks built inside it.

Immediately after the fall of France, the garrison was increased to four battalions, organized as two brigades, and measures were taken to put the fortress in a state of defense. These measures included: (a) defense against land attack on the north face, (b) protection of all possible landing places against sea attack, (c) local protection of coast defense batteries, (d) antiaircraft defense, and (e) provisioning the garrison and remaining civil population for a possible siege.

As regards (a), in addition to the construction of defenses on the north face, the existing trenches and tunnels in the north and northwest faces were strengthened, made proof against modern weapons, and fully armed and manned. Searchlights of various sizes were emplaced in the old gun embrasures to illuminate the whole of the north face up to the frontier fence. The tunnels were bunked up to capacity to hold the manning details, and cookhouses, latrines, etc., were provided as far as possible underground. Accommodation was wet and very uncomfortable. Old tunnels were used to their fullest extent, ventilated, drained, bunked, etc.

As regards (e), the objective set by the Chiefs of Staff was to provision the garrison and civil population for nine months. All women and children and all males not required by the Services, or for public utilities and essential distribution, were evacuated. Balanced stocks of ammunition and food were stored up to the capacity of available accommodation. Some of this accommodation was very bad, a good deal of food was lost through deterioration, and the garrison had to live on reserve rations to a great extent in order to insure a turn-over.

St. Michael's Cave, a ramification of stalactite caves about 500 feet up the "Rock" overlooking the harbor, was converted for ammunition storage. Brick and concrete magazines were built in all accessible portions of the cave, and concrete stairs were provided. The caves were very wet, and maintenance

and turn-over of ammunition entailed an enormous amount of labor.

Tunneling from 1940 to 1945

It is convenient to divide the whole period of war tunneling into three phases. Phase I covers the initial urgent requirements of the fortress, consisting primarily of accommodation for the garrison of the north face, with a tunneled hospital and safe storage of supplies as a second priority. This phase covers from approximately June 1940 to January 1942.

Phase II covers the largest yardage of excavation. At the conclusion of this phase, about March 1944, all essential work to enable the garrison to withstand a year's siege was virtually complete and the engineer tunneling companies began to be withdrawn.

During Phase III, only one tunneling company remained on the "Rock." This company worked under ideal conditions until its withdrawal, and the cessation of all tunneling work at the end of the war.

Phase I

The following were the main tasks of Phase I listed in order of priority:

(a) Expansion of the old galleries by additional lateral communications, additional inclines between the various levels, an additional gallery at ground level to cover the northeast approaches, and a shaft down to ground level below the north face for the use of reliefs by day and patrols by night. A large number of new embrasures were broken out to accommodate infantry weapons.

(b) A gallery at a slope of about one in twenty leading from the old system in the north face southwards to the western end of the lower waterwork's tunnel. This included additional and better accommodation for the garrison, some supply and ammunition storage and engine rooms for lighting and cooking in the whole of the northern system. The gallery provided covered communications to the back of the town and, via the waterwork's tunnel, to the east side above Catalan Bay.

(c) Tunneled accommodation for a water distilling plant, required as an insurance against the possible destruction of the catchments.

(d) Tunneled accommodations for a military hospital. This was combined with (e).

(e) A through east-west tunnel providing direct covered access to the east side of the rock (Harley Street).

(f) Tunneled accommodation for supplies on the southeast side of the "Rock."

(g) A big cave (Monkey's Cave) overlooking the sea on the east side of the "Rock" was enlarged and provided with a tunneled approach. A five-story convalescent hospital was built in the cave.

(h) A gun operation room with accommodation for manning details was excavated at the south end of the "Rock." The City Council continued their program of air raid shelters during this phase. Some of the shelters were appropriated to Military use as hospitals, etc.

Details of Construction

In order to save time and yardage of rock excavated, and to use materials immediately available, chambers were excavated approximately rectangular in section. Linings consisted of brick or concrete walls built clear of the rock sides with flat roofs supported on the walls or hung by means of mild steel rods grouted into the rock roof. A slight fall was provided in the length of the chamber. This method had two serious drawbacks. First, such linings took a very long time to build and, second, in the case of long or wet chambers, a great deal of water had to be carried away by the roofing sheets at the lower

end. In some cases, the allowable fall was so small that the slightest unevenness caused leakage at the overlaps. Galleries were not lined.

Concrete floors were laid throughout. Galleries were driven to a slight fall and a gutter provided on one side to carry off water seepage in galleries and chambers.

Tunneling Procedure

The tunneling companies confined themselves entirely to survey, blasting and operating such limited mucking machinery as could be supplied with air. The majority of mucking was done by hand using infantry and artillery working parties under supervision of the tunnelers. Removal was by Decauville side-tipping trucks pushed by hand. Tunnelers and mucking parties normally worked three eight-hour shifts, the latter having a set task of trucks per head. The tunneler's task was normally one round per shift.

A diamond drilling section of a Canadian tunneling company did essential work in exploring the "Rock" for tunnel planning. Apart from the great fault which occurs about a third of the way along the "Rock" from the south end, there were many unpredictable pockets of inferior rock, and time spent in exploration was fully repaid. A one inch diameter core was removed and the line of the drill reconstructed by reassembling the cores. Holes were also drilled for power and signal cables.

Phase II

By January 1942, most of the excavation for the first program had been completed, although construction lagged far behind. To speed up construction work, Iris and Romney and Nissen span hutting was ordered from England, and future chambering was excavated to accommodate these with one to two feet to spare all around. Sheets were given a priming coat of red oxide and two coats of lead base or bitumastic paint before erection. (When paint ran out, coal tar was obtained from the local gas works.) The inside was given a coat of limewash after completion. Besides being very quick to put up and shedding water well, this method gave a more stable roof which allowed chambering to be done in more inferior rock. Chambers could be spaced closer together. The tunnelers got very expert at trimming the chambers to an accurate radius, but tunneling man-hours per foot of floor space provided rose slightly. It was realized that, once erected, the sheeting could not be treated again and its life was limited. In view of the great advantage of this system, however, and the fact that the sheeting would probably survive to the end of the war, in spite of the warm damp conditions promoting rust, this was accepted.

Planning

By now, there had been a great improvement in the equipment situation and planning could proceed on bolder lines. The following were the main items:

(a) Two tunneled magazines were planned for ammunition storage, one in the north and one in the south to serve the two brigade areas. Each was to have road access, lorry size galleries and chambers lined with thirty-five foot span huts. Good rock was chosen in each case.

(b) A lorry-size tunnel just inside the cliff face on the east side of the "Rock" connecting from the chambers already made for supplies on the east side to the naval oil tanks (Arow Street).

(c) Further supply and accommodation chambers at the north end of Arow Street.

(d) A tunneled connection from (c) to the Admiralty oil and water tanks and on to the dockyard tunnel at Sandy Bay.

(e) Further supply chambers along Harley Street.

(f) Tunneled accommodation for the two brigade headquarters.

(g) A lorry-size tunnel along the west side of the "Rock" connecting up Gort's hospital, the two brigade headquarters, the northern magazine and the northern tunnel system. This was named the Great North Road.

(h) A chamber at the south end of the "Rock" for petrol storage with road access on a down grade from a disused quarry. The other end of the chamber connected with the sea, also on a down grade, so that, in case of fire, burning petrol would discharge harmlessly into the water.

(i) Emplacement of a six-inch three-gun battery in the cliff on the east side of the "Rock." The gun pivots were about ten feet from the edge of the cliff giving a training arc of 150 degrees. Magazines, stores and accommodation were to be tunneled immediately behind the guns. An incline of ample dimensions with rails and hoist gave access from the tunnel system on the southeast side.

(j) The lower part of St. Michael's Cave had always been difficult of access and involved a long carry up and down some hundred steps. Direct horizontal access from outside was planned to debouch on an existing road.

In addition, it was planned to use a further cave connected with, but not accessible from, the main cave and some 150 feet below the main entrance. This was to be done by means of a second horizontal drive from outside.

(k) A shaft leading down from the tunnel system on the east side to a small beach at the base of the cliff. This was to be combined with a boat hoist in a section of rock overhanging the water. These were to provide facilities for supplying the garrison, during siege, by submarine.

(l) A communication tunnel leading from the naval tanks to the east end of the north front, thus completing the entire circuit of the "Rock" without coming into the open.

(m) Various tunneling work connected with various defenses.

Execution of Plan

This plan was carried out with a few modifications and additions introduced as the work proceeded. The most urgent items were the two magazines. This work was the first to be executed as a deliberate mining operation on a carefully prepared plan which included the disposal of the enormous quantities of spoil produced. The southern magazine was eventually connected by a lorry-size tunnel with the east end of Harley Street with stores and personnel accommodation, latrines, cookhouses, etc., for the Southern Brigade.

The Great North Road was connected by an east-west lorry-size tunnel (Fossway), with the extensive excavations on the east side of the "Rock."

A thirty degree incline was driven from the Great North Road near Southern Brigade headquarters to the dockyard tunnel.

The petrol storage chamber was completed though never used as such, and was connected to other accommodation.

Before work on the 6-inch battery had gone very far, the plan was modified to take a 5.25-inch three-gun battery. No guns of any caliber materialized and this extensive excavation was converted to accommodate a large engineer workshop, central bakery and other accommodation. The Fossway mentioned above terminated here.

The lower tunnel into St. Michael's Cave was successfully driven. The interesting feature of this was the very difficult underground survey, involving a large number of stations, some of which were very difficult of access.

The boat hoist never materialized. By the time it came to detailed planning, it was found that spoil, shot into the

sea from above, had turned two or three fathoms of water into a beach. This fact is interesting as showing the enormous quantities of spoil excavated.

Water Supply

A system of ring mains was installed entirely inside the rock or on the surface on the sheltered east side. These mains connected up with all sources of supply—naval, army and civil tanks and both the navy and army condenser plants. By utilizing external sources—wells on the north front, and water imported by barge from Algeciras—to the fullest extent for the current requirements of the garrison and civil population, stocks of water in the rock tanks were kept always at a figure which would tide the garrison, the fleet and the civil population over the next rains. Although the medical authorities had stated that bacteriological infection of the catchments from the air was improbable, chlorinators were installed for use if required at all points where water was drawn from the tanks. The civil brackish water supply was also brought into the tunnels, supplemented by a submersible electric pump installed in the sea on the southeast side of the "Rock." Expense tanks for both fresh and washing water were provided in each section of the tunnels, to be filled from the mains. These were tunneled chambers lined with concrete and sealed against seepage, and were of the order of 100,000 gallons each.

Phase III

The size of chambers had been progressively increased as work went on, and with the introduction of excavating machinery and five-ton lorries into the tunnels, larger rock could be expeditiously dealt with. These machines required a greater height in which to work, and the greater the space the less the concentration of carbon monoxide.

Chambers up to forty feet wide and forty-five feet high were excavated, the roof being formed to camber for safety. Such chambers were only suitable for stores that could be stacked to this height unless provided with one or more floors. The economy of tunneling time was great, not only in the excavation of the chambers themselves but also in cutting down unproductive mining for galleries and ventilation.

General

For ease of construction, all entrances to tunnel systems were straight, there being generally fifty to 100 feet of straight drive before chambering was started. This being so, although the excavations were to all intents and purposes bomb proof, there was the possibility of considerable damage being done by blast following the explosion of a bomb or shell at the tunnel entrance. The advice of the Ministry of Home Security was sought as to the type of protection which could be provided, it being considered that the conventional blast walls would seriously impede traffic, making the use of lorries underground well nigh impossible.

As a result of experiments carried out by the Ministry, a "blast trap" was adopted on the principle of absorbing the blast in soft material and at the same time making it turn corners. The sharper the corners the better, but for a lorry-size tunnel these had to be eased off. These traps were excavated after the internal tunneling work was finished, the last operation being the insertion of the concrete plug into the original straight tunnel. Traps of this type were designed and constructed to permit the passage of three-ton lorries with little or no inconvenience.

Tunnel Spoil

On the east side of the "Rock," all adits came out on the cliff face and spoil was dumped in the sea. On the

southeast side, the spoil was used to provide parking space for transport between the tunnel entrances and the sea. Spoil from the southern and northern magazines provided road access to the tunnel entrances. Where spoil had to be lorried away, timber hoppers were built. In one case, rough screening was used to grade the spoil into a battery of hoppers; this was very useful for surfacing the airfield and saved a lot of crushing.

In the latter stages, when more transport was available and crushing and screening equipment had been installed, nearly all spoil was used on Admiralty and War Department projects. Nevertheless, some nasty scars were made by spoil which had to be dumped down the hill side in the early stages for lack of any other means of disposal.

Ventilation

During actual excavation, the normal practice of ventilation was used. Tunnels and chambers were planned to take all possible advantage of natural ventilation; this was supplemented as necessary by air-driven fans and metal or canvas ducting.

Ventilation for personnel accommodation was provided by electric fans (taking power from the underground grid) and metal ducting. The circulation was designed to assist the natural flow of air, although in practice it was found extremely difficult to predict what this would be.

Gas filters were fitted on a by-pass at all ventilation intakes and arrangements made for sealing tunnel entrances in the event of a gas attack. How this would have worked in practice it is impossible to say, but, since the tunnel entrances were nearly all situated well above sea level, it is doubtful whether any appreciable amount of gas would have tended to find its way in.

In the case of underground engine rooms, considerable trouble was experienced in dissipating the large amount of heat generated; the natural exhaust of engine room air by the radiator fans (ducted to the open) was quite insufficient and considerable forced draught had to be provided. No ordinary gas filter could cope with this and the engine rooms were consequently placed outside the gas lock.

With one exception, no attempt was made to condition the air; any attempt to do so on such a vast scale would have been impracticable. Due to the cooling of the outside air by contact with the rock and the high humidity, forced ventilation tended to cause excessive condensation. It was found that ventilation must be kept down to a minimum consistent with an adequate change of air.

Models

The plaster model of the "Rock," used in peace time for the information of visitors, was of great value for indicating works on the ground, but it was impossible to show tunnels on it. A new model was made, consisting of a framework of plain galvanized wire. Horizontal wires following the contours at 100 foot vertical intervals, these wires being held together by wires soldered at right angles to them. The vertical scale was twice the horizontal scale. Tunnels were made of strips of tin plate painted red and soldered to the framework. The model was made and kept up-to-date by the tunnelers and was a great success. It was quite easy for a newcomer to learn his three dimensional geography of the "Rock," and it proved an enormous help in planning. In fact, planning for new tunnels was indicated on the model and studied by the tunnelers before survey commenced.

Conclusion

The provision of the Gibralter tunnels was an enormous task and involved the excavation out of the solid rock of

over a million cubic yards during a period of approximately five years. The start was slow, equipment was practically non-existent, experience of mining in Gibraltar meager, but this was compensated for by the enthusiasm of the tunnelers. As a threat of investment of the fortress receded, and with the arrival of more equipment and personnel, properly planned schemes were evolved and the "holes" of late 1940 and early 1941 were, on paper at any rate, all connected up by drivers and inclines. In due course, these plans were executed and further plans were drawn, more ambitious still. Underground storage, workshops, bakeries, roads, hospitals, offices, headquarters, were provided: in fact, everything which could be done to make possible the troglodyte existence which would have been the lot of the garrison under siege conditions.

Of all the lessons which can be learned from the task, by far the most important is that planning from all aspects must be kept well ahead, and that no tunnel, however desirable, should be started unless it conform to a general plan. Only too often it was found that "highly important" tunnels in the early days were, on second thought, not nearly so important, and their presence prejudiced the later development of the area in which they had been located.

The Submarine in Modern Warfare

Translated and digested by the MILITARY REVIEW from a French article by René La Bruyère in "Journal de Genève" (Switzerland) 3 October 1946.

AT the present time we are in a state of uncertainty as to the changes in construction and tactical employment that will be made by naval forces as a result of the introduction of nuclear energy.

One French naval authority informs us that the war vessel of the future must possess the form of a tortoise shell in order to resist the effects of the explosion of atomic bombs in the vicinity of its superstructures, and in order to escape as much as possible from the thermal, mechanical, physical and radio-active effects that attend the disintegration of matter.

This ship must be provided with modern artillery in order to intercept atomic bombs released against it (either by planes or otherwise), through the medium of radio energy aided by remote control devices. Every conceivable hypothesis is permitted in this respect, and it appears as though the science of radio activity is opening a limitless field of action for our research. The weakness of the vessel described lies in the fact that it is not exactly evident just how it is to defend itself against an underwater explosion.

The submarine will have a place in the ranks of this navy of tomorrow, but before explaining why, let us note a few facts about the submarine. This vessel, as we know it today, is hardly fifty years old. Conceived, at first, as nothing but a simple torpedo vessel attacking under the surface with torpedoes, it was used by the Germans in World War I as a redoubtable blockade weapon which almost caused the Allies to lose the war by the toll it took of their merchant marine.

In World War II, the Germans were preparing to repeat their performance

when effective countermeasures caused the submarine to lose some of its advantages. It was necessary to resort to continuous submersion which was made possible by the *Schnorkel* which permitted Diesel motors to operate under water.

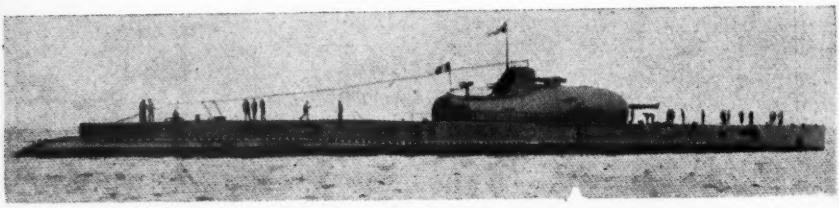
This is the stage in which we find the submarine at the present time. It is a vessel which possesses a radius of action under the surface with no other limit than the capacity of the vessel's fuel tanks: a vessel which no longer needs to return to the surface to travel under other motive power than that provided by its storage batteries. Hence it is a ship which is difficult to detect, and that is what, in the navy of the future, gives the submarine a special tactical value.

While the surface vessel is presented to us as a vulnerable prey for the atomic bomb, the submarine appears to be capable, at least of some means of escape from it, except in the case where the enemy is able to attack it with atomic depth bombs over extensive areas.

The answer to the problem of defense against the submarine lies in knowing how it may attack. What are its offensive capabilities? First of all, consider the modern torpedo which leaves no wake, and which may be guided by radio or provided with an acoustic guiding device. Can these torpedoes carry an atomic charge? Would not the effects of this explosion be just as dangerous for the submarine as for the target? This remains to be seen, but, even employing today's torpedoes, the submarine is capable of playing an extremely important role in modern warfare.

We know that the submarine has, for a very long time, employed very little artillery, although on the *Surcouf* this artillery reached a caliber of 203-mm with two turret guns. This means that when the problem of firing an atomic bomb from the deck of a vessel has been solved, the submarine, during the few moments it is on the surface will become the realization of the dream of atomic bombardment whether used against targets on the sea, the land or in the air. It will make use of its capacity for rapid submersion, once it has dealt its blow, in order to escape the reply of the enemy. The surface ship will have to be able to employ the whole gamut of "jet-propelled artillery" and hurl atomic depth bombs directed by radio.

Will we some day see the under-water airplane carrier? Will it be possible to build on its decks a hangar sheltering several planes which can be launched by catapult? The *Surcouf* carried one plane. All that we should have to do now is to increase the number of planes. It is a question of displacement. But, as the tonnage increases, the maneuvering qual-



The French Submarine *Surcouf*.

ities of the submarine become progressively worse. The solution of the problem will be found in a compromise between the effort to reduce weight and that of installing light planes on board the submarine.

Lessons of War Through the Ages

Digested by the MILITARY REVIEW from an article by Major D. H. Donovan in "The Journal of the United Service Institution of India" October 1946.

BISMARCK said: "The war of 1870 will be child's play compared with that of tomorrow." Transfer this statement to our future. We have emerged victorious from the most devastating war the world has seen, and if we look more deeply into this last struggle we shall see that Bismarck's statement is indeed true of our "tomorrow."

Up to today, the law of the jungle has prevailed. Might has been right. As long as nation looks upon nation with suspicion, force will be the hallmark of success. War, then, is not only a possibility but a probability; when, we cannot tell. Thus it is the duty of all soldiers to study the art of war, for in studying the past, they will automatically look to the future. Many may say that the object will be achieved without reflection and meditation, but in fact that is not true. I defy anyone to name any great general who has mastered his profession without those two aids. Even the great Napoleon Bonaparte once said: "It is not some familiar spirit which suddenly and secretly discloses to me what I have to say or do in a case unexpected by others; it is reflection, meditation."

Political opinions are gradually swinging toward peace in the future, and toward fear of another war, owing to the discovery of the "atom." Their influence will blind the nation to the possibility of war. How much will that influence affect the army and its military studies? We all know the army has been closely linked with the budget. To stop money for the army is to cut off its life blood and thus halt advancement in every sphere of military profession. If, then, our ideas and learning cannot be put into practice, how can our soldiers and leaders of tomorrow be anything but mentally and professionally stymied? To study the future we must study the past, and I propose to trace the effects of the aftermaths of all our great wars from Marlborough's time to 1939, and to prove how history in every case repeated itself as regularly as the clock hand circles every hour.

In 1697, England signed the Peace of Ryswick with Louis XIV; it was nothing more than a truce to give each side time to regroup and refit, so as to renew the struggle later. France availed itself of the valuable opportunity; England followed up the affair with wholesale reductions, the result of which put Marlborough in dire straits at the outbreak of the War of the Spanish Succession. Not until it was nearly too late did Parliament vote large "augmentations" on behalf of the army; new regiments had to be raised and trained; methods of warfare taught to new soldiers. Why could not all this have been done in the interim period of 1697 to 1702, during which time a formidable army could have been raised? A highly organized and well equipped British Army at that time might have averted that long and tedious war.

Added to the difficulties of those days was the cosmopolitan nature of the British Army, whose generals relied to a vast

extent on the whims and promises of European potentates whose troops they hired. Thus we see Marlborough, our greatest general, handicapped and thwarted by the politicians of his day; striving to reorganize and train in order to form an army worthy of his command, but frustrated by men who lacked foresight for war to the favor of peace and commerce.

Marlborough's wars lasted from 1702 to 1714. He taught not only England but Europe a new method in the application of war—that the comfort and administration of his force was as important as the battle itself. His greatest teaching was mobility and speed of maneuver, thereby causing surprise concentration of force at the vital point. Those were the foremost lessons learned from the War of the Spanish Succession. They should have been invaluable for a future war.

England needed peace after the Peace of Utrecht in 1713, and Walpole gave it to her; under his guidance she grew rich and prosperous; but the army failed to keep pace with the times, and instead of thinking and training for the future, the services slid to a standstill, and only studied the art of dress and fancy uniforms. The science of war was discouraged for fear it might come about.

This state of affairs continued till the Seven Years War, from 1756 to 1763, when William Pitt tried to relight the glories of the past. To a certain extent, he did reorganize the army, and in fact was the first to attempt conscription in England. But the army was stagnant; its leaders docile and inert. They had forgotten Marlborough's lessons and cared less. It was left for William Pitt to pull the nation through those hard and difficult years, and guide the army and its leaders along a path they should have seen for themselves.

Wolfe, victor of Quebec, was about the sole inventor of a new form of tactics; he taught the use of two ranks and a higher speed of fire from the muskets. By the use of two ranks he taught one of the greatest principles of war —freedom of action. But it was forgotten, and did not reappear until it was taught by Sir John Moore. Wolfe did indeed teach all the lessons of fire control, formations and equipment for battle that his successor, Moore, taught at Shorncliffe Camp before the Peninsular War.

Thus once again, from 1763 to 1808, methods of warfare retreated rather than advanced—probably because of the country's fear of the future. Lessons taught by Wolfe and Pitt the Elder were forgotten and were not remembered again until the rude awakening of the Napoleonic Wars, in which England struggled for her very existence. In 1784, England was once more at war with revolutionary France; it lasted until 1802, during which time British leaders persisted in the policy now known as "penny packets." They had forgotten Marlborough's lessons of preponderance of force at the decisive point, and both British and French armies were led by uninspired leaders.

Let us jump to 1802 and study men such as Moore, Wellington, the Duke of York and Napoleon. The Duke of York set about reforming the army, giving to it an organization and hope for the future which set its morale far higher than any previous level. Nevertheless, when Napoleon threatened England, she was sadly unprepared. It was left to Castlereagh, Secretary of War, to hold the reins; he it was who provided the country not only with an adequate striking force, but also with the means of keeping it in the field. The spirit of the country was raised, but adequate weapons for her defense were not available. In short, the struggle between Napoleon and Wellington lasted from 1808 to 1815—a period which saw the tactics of the thin

red line against the French massed formations.

England had far fewer troops than her opponent, and it was probably because of this that the Duke of Wellington's great teaching was economy of force; he did, however, teach the army the need to fight from reverse slopes—a teaching which has held to the present day. But perhaps his greatest teaching of all was that of his epic battle of Salamanca in 1812, when he showed how, by rapidly switching from the defensive to the offensive, victory could be gained.

What of Wellington's adversary, Napoleon? Here was a great soldier steeped in politics—with the governing and ruling of a nation as well as the direction of her armies. His great teaching to the world in the art of war was in the use of artillery; for his mass formation tactics, though successful against his European opponents, proved useless against the British. But Napoleon was a master in the art of war, and taught the world the great advantage to be gained out of massed gun fire. He was, in fact, expounding the teaching put forth by Marlborough, Conde, and Turenne.

Three lessons, then, emerged from the Napoleonic struggle: fire power, speed of maneuver, and success of massed artillery. The British Army was now the most toasted and powerful in Europe. The fame of her General, the Iron Duke, was established; but she needed to be reorganized in the light of those three lessons, and it was for the Duke to give the word. But he did not. England became wrapped in politics; she longed for peace and plenty, the army sank again into its historical oblivion.

Once more, then, the huge forces with which England had been saved went into the background. Its leaders wasted their time; the army was to a great extent disbanded, and what remained sank into the abyss of stagnation, in which state it found itself on the declaration of war with Holy Russia in 1854.

The Crimean War was a disgrace to our nation, to our generals. Castlereagh's reorganization had been cast to the four winds; the army fought without a policy, without reserves. It was in desperate plight in the winter of 1854, and the conscience of the nation was aroused; reinforcements and medical aid were dispatched hurriedly, but it cannot be denied that the Crimean War did more than much to lower the hard-earned prestige of the British Army. That prestige was not regained until it was fought for on the bloody fields of Flanders half a century hence.

There were, however, a few lessons learned during the struggle for Sevastopol. The Russian force far exceeded our army in numbers, but the excellence of the new British Minie rifle made up for our lack of numbers, thus conclusively proving the importance of fire power and the denial of ground by fire. It was probably from the Crimean War that we could trace the great striving by every European power for quick-firing weapons controlled by the minimum number of men. The next lesson the Crimean War taught was the need for medical assistance in war—the fact that the sooner a casualty was returned to the front line, the easier would it be for an army to maintain its numbers in the field. Lastly, the war taught the advantage to be gained from a unified control of operations, and the benefits to be derived from a more serious study of the military art.

Some advances were made in the army from this period to the Boer War, but very few considering that the Prussians had soundly defeated the French in 1870 at Metz. The French, masters of national warfare, had been defeated by a hitherto mercenary nation. Here was a signal warning to England, but it was given in vain. Isolation was the order of the day.

England's leaders failed to grasp how seriously the balance of power in England had been affected, and how difficult would be our policy in our colonial empire with a Europe which looked upon our army as a second-class force. Had our generals studied the Franco-Prussian War, we would have had the best army in Europe. But again, nation and generals feared war, and refused to study war, and so we come to 1914 and the outbreak of World War I.

That war showed little in the art of war to the military student. It was the only static war the world has even seen —a freak war in the history of the art, and a war which, in all probability, will never be repeated. For the purpose of this article, we may refer to it but little, with no very great loss. It was essentially a scientist's war, when very formidable weapons came into being—the machine gun, the tank, the airplane. Throughout the war in Flanders we saw the armies struggling for power in the maneuvering of its forces, and for command in its fire power. Little or no attention was paid to the British invention of the tank in modern war or even as a formidable weapon in support of infantry. The airplane was more a Galahad of the air than a serious weapon in attack or defense.

Had generals been more astute, they would have seen greater possibilities in these weapons—but armies had become imbued with the idea of static trench warfare, and not until towards the end did we see the success to be achieved from mobility and maneuvers. Winston Churchill was perhaps one of the few men who realized the necessity for surprising the enemy by maneuver when he sent an expeditionary force to Gallipoli; had it succeeded it would have been a very great feat of strategy. And had Allenby commanded on the Western Front, the history of those years might have been different, for he was a student of the future school of thought—a man with a fertile mind and breadth of conception.

Let us then study the lessons of those years of war. Mobility and maneuver are once again on the front page, for he who wins the war of maneuver wins the day. To assist both those lessons, we saw the greater use of the motor car and the invention of the tank and the greater use of the machine gun. Here was food for thought, and, looked at in retrospect, it appears obvious that the army needed organizing by virtue of these very lessons. It is remarkable that the terrific potentiality of those lessons was not fully appreciated.

History repeated itself. The nation was tired and so were its leaders, who insisted on disbandment of the forces to the minimum; it left nothing more than a meager police force, with a depleted cadre of regular officers, and they were not encouraged to think on the lines of war, but simply and solely to do as they were told. Money was short, and consequently weapons and ammunition were scarce; scientists were not greatly encouraged to invent or produce new weapons or ideas in the military field.

That was the mood of the country between 1918 to 1939, during which Germany prepared for *Blitzkrieg*. Hitler's leaders were far-seeing; they studied the lessons of the past, and evolved new methods of war for the future. Why should England, a country renowned for its skill at arms, not have been able to anticipate the future and train on those lines? In 1939, she found herself untrained, lacking equipment and weapons. It was an act of God that she survived the war's earliest stages, and it is probably the last occasion on which its traditionally hazy policy will escape its just deserts. Let us assume, then, that this is a policy of the past, and that in the future we may more seriously study the future war. Let

us study the methods of war evolved during 1939-45.

Unlike World War I, we have seen terrific speed of maneuver added to a colossal fire power; we have seen the dexterous use of airborne and parachute troops brought into action by gliders and troop-carrying airplanes; we have seen the use of more and more automatic weapons. We have seen battles rolling on to battles at hitherto unbelievable speeds, as witness the famous Eighth Army's advance, withdrawal and renewed advance across 2,000 miles of arid desert. Then there is the lesson of the rocket-firing airplane being used for shock tactics in breaking the opponent's defense—a weapon still in its infancy. There was General Slim's use of the air when he transferred a division from one part of the front to the other in Burma. Field Marshal Montgomery taught the world the devastating effect of massed artillery firing on given points—a lesson the Germans had failed to learn even from the last war. How, then, are we to apply these lessons in the war of "tomorrow"?

Methods of today will not be those of the future—or, rather, they should not be so. "War," said von Moltke, "teaches war." Therefore, to those of us who have learned warfare from this war, it is obvious that the next struggle will be one of even higher speed, maneuver and fire power than that of today. It will be a contest of explosion and energy that will make military leaders and scientists of today gasp with unbelief. How can we reorganize our army and train for this phenomenon?

Take first the infantry soldier. He is equipped with a bolt-loading rifle, capable of firing only twenty well-aimed rounds in a minute at the maximum. Here is one tip from the late war—arm him with an automatic rifle which is two pounds lighter than his present one. Let it fire a .275 bullet, thus lightening the weight of his ammunition. What are the drawbacks? I see none. The infantry soldier, even in the future war, must be the focal point of the army. Why not, then, look to his weapons and arm him in accordance with the times?

That brings us to mobility—for our army must be doubly mobile to what it is today. To aid us over this point, we must call in the scientist, and ask him to build for us a vehicle capable of traveling in the air as easily at it does along the ground. Such a vehicle would open up vast fields in the art of war; it would change its very characteristics, for then the enemy would have a rear as vulnerable as his front. He would, in fact, then be able to besiege our opponents on the battlefield—hitherto an exceedingly difficult task. The real air war will have begun.

Artillery, too, must change its ideas. We have seen how a small number of self-propelled guns were used with great effect; how quickly they could be brought in and out of action. The advantages of a self-propelled gun are enormous, and to any thinking man they will most definitely supersede the old methods of the gun being dragged behind some kind of powerful vehicle. Besides all this, in our real air war a self-propelled gun would be transportated by airplane far more easily than one which is attached.

How can radar be turned to advantage by the army in general? I am not a scientist and know little about radar, but I do suggest that if it were used by every company to locate enemy positions and enemy patrols, needless casualties would be avoided. This however, is a matter for the scientists, but it is not beyond the bounds of possibility that we may live to see this use of radar adopted and accepted, as is the mine detector, for infantry today.

Air power in the next war will be even more important than it is today. Jet-

propelled airplanes will step up the speed of aerial warfare—and the army will have to follow suit. In the field of armor, how can we profit from our present-day experience? We have seen the vital need for heavy guns with an effective range, but not so heavy that the tank becomes a propelled gun; the use of the tank, I feel, reached its zenith during the late war, but its brother-in-arms, the flame thrower, has far reaching possibilities, and should invariably be used in a counterattack role before the infantry has managed to bring up its antitank weapons.

The atom bomb has arrived—but it will not stop war. Scientists will undoubtedly evolve a counter which will render this new explosive harmless, whether it be by cosmic-rays or by radar controlled atom bomb exploded by wireless rays on reaching the approaching bomb of the enemy. But whatever method is employed, the atom bomb is not such a great weapon as it is made out to be. It has cost enormous sums of money, and is the result of hundreds and thousands of men and women working intensively for five years. Until some cheaper method and some commoner substance than uranium is discovered, it will be more a dream for war than a reality. The discovery of the atom bomb has, I fear, made some people complacent, in that they say war is now a thing of the past.

This article has shown how history repeats itself. We must break this inevitable rule. We must break away from the accepted theory that the army is ruled by the budget. Let the army rule the budget rather than be ruled by it—and then we shall have the equipment of our desire and thereby insure world peace. Expenditure on scientific research for the army must be augmented. The profession of arms must be popularized to boys at school; and the nation must be encouraged to look upon its soldiers with pride, rather than think of them as an unnecessary burden.

Drastic changes in policy and ideas are needed to keep pace with the times. We must strain towards the answer for the future as a means of insurance for keeping the fruits of the labors we have won at such great cost.

New British Naval Aircraft

Digested by the MILITARY REVIEW from an article by Major Oliver Stewart in "The Navy" (Great Britain) December 1946.

WHILE speculation continues upon the effects which rocket motors and atomic bombs will have upon the whole structure of naval aviation and upon the kinds of aircraft that are required, steady, normal development must go forward with aircraft of conventional pattern.

Even if this kind of development may seem dull, it is as important as ever. There may be, and indeed are likely to be, radical changes in naval aircraft; but ordinary development must continue first as a lead-in to these changes and then as a background to them. Consequently it is useful to keep a sharp eye upon the kinds of aircraft in actual use and on order.

A new idea in naval aircraft is the Blackburn Firebrand. In the Mark V version, this aircraft is a single-seat torpedo-carrier. It marks the culminating point of a certain tactical theory. This theory, put in the crudest form, is that it should be the function of an aircraft

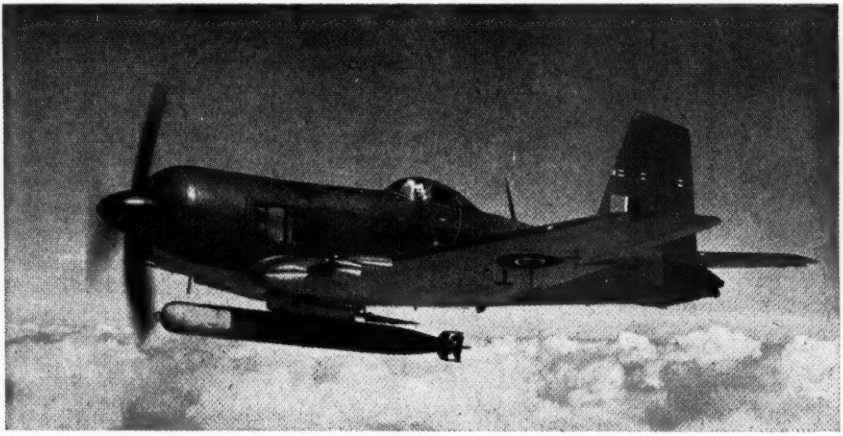
to pack the largest striking power into the smallest space and to carry it with the fewest crew members.

It has been the practice in the past to produce airplanes which are aerodynamically clean and are good performers, and then to clutter them up with innumerable articles of equipment until their performance has been wrecked. Almost every single-seat fighter that has been made has gone through this process.

In the Firebrand, the aircraft started its career with the idea of torpedo carrying in view. It was a strange idea when first conceived, because the Firebrand is not a very large airplane. Its overall weight with torpedo loaded is 16,100 pounds. Its performance, with a top speed of over 350 miles an hour, is of the fighter order and its powers of maneuver are good.

It will be seen, therefore, that the idea behind the Firebrand is to provide an aircraft which can strike hard in a naval action and which, having struck, becomes what is to all intents and purposes a fighter, able to look after itself. It is not to be supposed that a single-seater built to carry a torpedo can achieve full fighter performance; but the Firebrand is not far behind fighter performance so far as piston-engine aircraft are concerned.

Whether this line of single-seat torpedo carrier will be continued cannot yet be predicted. Much will depend upon whether the Firebrand wins the confidence of naval pilots.



Torpedo-carrying Blackburn Firebrand.

Meanwhile, the kind of aircraft represented by the Fairey Barracuda may be said to be in process of disappearing. No matter how the engine power is put up, this kind of machine is too slow and too clumsy for modern carrier work. It is not to be supposed that the larger torpedo airplanes will not continue in existence for some time; but that they are gradually dying out is certain.

Strike aircraft will be faster and smaller. The Barracuda is designed to carry a crew of three, but it is likely that the crew of strike aircraft in the normal line of development will be reduced to two or—as in the Firebrand—one.

Fighters for the fleet have been as

much disturbed in their development by the coming of jet and rocket machines as other types. No one could today say with any confidence how long the normal, single-engined, single-seat, piston-engined aircraft will continue to be the mainstay of carrier-borne fighters.

The Fairey Firefly, with a top speed at 20,000 feet of over 360 miles an hour, has attracted a good deal of attention and it was a wise decision that led to the introduction of a Firefly Trainer, in which there is accommodation for instructor and pupil. The Trainer is a help in preparing pilots for the high-powered machines.

But when the performance of the Firefly fighter is examined in relation to aircraft like the de Havilland Vampire, it is seen that it is a great deal slower, that its climb is poorer, its service ceiling (33,000 feet) no better, and its armament (four 20-millimeter cannon) the same. In one respect, however, it retains an advantage—duration.

The range of a Fairey Firefly is approximately 700 miles, which is greater than the range of a comparable jet aircraft; but its endurance, when the engine setting is appropriately arranged, is very much greater than anything the jet machine could achieve.

Is air endurance of value to a shipborne aircraft? Upon the answer to that question depends the wisdom of continuing the energetic development of piston-engined fighters. On that question also depends the wisdom of undertaking the development of fighters with gas turbines driving airscrews.

In general, it is the view today that the fighter of the future will have no airscrew; that it will be driven by recoil or by jet as is the Meteor. But many big engine makers are working upon gas turbines arranged to drive airscrews. And the advantage held out for these units is that they will improve fuel consumption and therefore aircraft range and endurance.

It would appear that, if the naval need for range and endurance is great, there might be a place among naval aircraft for a fighter equipped with a gas turbine driving an airscrew. But it must be added that there is a body of expert opinion in Britain which holds that the development of the gas turbine and airscrew combination is a retrograde step. It is argued that the airscrew has always been a nuisance—and a noisy nuisance at that—and that we should be mad, now that there is a chance to get rid of it, not to take it.

It is admitted on all sides that the plain jet for propulsion is superior to the airscrew when extremely high speeds are concerned. And if naval aviation is looking forward, it must be concerned with extremely high speeds. So, perhaps the most that can be said for the gas turbine and airscrew combination is that it might have a very brief life as an interim arrangement for shipborne fighters, and a slightly longer life for torpedo carriers and larger machines.

Altogether, although we all await the radical changes that must take place in naval aircraft and air equipment in general, there is plenty of interest in the normal lines of development.

Resettlement Center

Digested by the MILITARY REVIEW from an article by Squadron Leader Frank Tilsley in "Royal Air Force Journal" (Great Britain) January 1946.

No. 1 Resettlement Center, Scarborough, the first of three such RAF Centers, was opened in May 1945, and by early 1946 more than three hundred ex-Prisoners of War had completed a course of approximately three months' duration and, for the most part, gone back into civilian life. All but a handful of difficult cases had been launched into careers or into courses of training for careers. Many have gone back to their old jobs. Others have gone into new jobs found for them by the Center.

"Not that finding jobs for these chaps —we call them students—is our main function," explained the Commanding Officer. "Our main function is to ease their passage into civilian life, to get them back into the swim of things, to fill the gap in their minds left by years of imprisonment in Germany, to adjust their outlook so that they can settle down again and live a happy life."

Settling down again is a very difficult job if you have spent several years in a German prison camp. Quite apart from men who have suffered ill-treatment, the hard conditions of living in the camps, and the emptiness of being cut off almost entirely from the life of these islands have an unfortunate effect on men's minds. When they first come to the Center many of them are cynical and lethargic, Some cannot make up their minds about the most trifling problems. Many lack self-confidence.

They are usually out of the picture regarding the most elementary features of modern British life—many have never heard of such things as utility furniture, Mulberry Harbor and Spam, and the complications of rationing, coupons, and so on are bewildering to them. They have to be provided, in three months, with the background they have lost, and this has to be provided in the right way, gently, not by the high pressure tactics necessary on normal service courses.

To give them this background, and to prepare them for the future, a period of one and one-half hours each morning is devoted to lectures and discussions on the changes brought about during the past three or four years. Attendance is compulsory—the only part of the course which is compulsory.

Apart from this one and one-half hour period each morning, there are further morning classes in a variety of subjects which may be classified as commercial (typing, bookkeeping, etc.), technical (electricity, radio, metalwork, woodwork, etc.) and academic (English, math, languages, etc.). Students usually take a little time to make up their minds which classes to attend, and they are helped in the process, discreetly, by the staff instructors. These instructors regard it as part of their job to get to know the fellows as individuals rather than students.

"In fact," said one of them, "it is the main part of our job to help them with their personal difficulties. We are coaches, rather than instructors—something after the style of university tutors. We get to know them quickly by sharing their interests—have a round of golf with them, or a game of tennis. You get to know a chap a lot better if you both go to the cinema one night or take part in the same debating society, or even go for a walk together along the sands.

It is partly for this reason that so much time is given over to games and recreations of all sorts. Morning is given over to work, afternoon to games, and a wide variety of recreations are available

for the evenings—dances, a station cinema, a very popular music circle, concerts and so forth. The facilities for afternoon games are magnificent—cricket in ideal surroundings, first-rate tennis courts, a soccer field as flat as a billiard table, and the glorious South Cliff golf course. And for those who do not want organized games, there is the sea, for boating, swimming, fishing or merely for strolling; there are the cliffs to climb, and magnificent rolling country for miles around.

A course as highly individualized as this is always capable of adaptation to cope with the unusual case. A good example is the way in which practical business experience is given to some of the men. This began when two of them approached one of the instructors and asked him if there were any books in the library on inn-keeping, as this was the business they intended to take up.

"I replied that I had no such books," the instructor told me, "but if they wanted to know how to run a pub, then the best way was to go and run one: so we went to the 'local' and explained the position to the publican. The position was clear; here two able-bodied, intelligent and keen young men willing to work for nothing in order to learn a trade, and here was the manager of a business, short of labor. They were immediately installed. They worked in the hotel for a couple of months and learned the cellar work, storage, etc., and finally got sufficient practical working knowledge to run their own pubs, which is what they intend to do."

Now there are several students getting practical experience by similar external arrangements: an ex-motor mechanic at a local garage, an architect is with the municipal authority, a carpet planner is getting his hand in once more in the furnishing department of a large store, three of the fellows with a taste for teaching, but no experience, spend part of their time at local elementary schools. And so on.

It is difficult to measure the success of a unit of this description, for there is only one basis on which comparisons can be made—that is, the difference in outlook and capacity between the men when they come in and when they go out. But they certainly go out in much better shape than when they came in—heavier, fitter, more self-assured, more cheerful, and with very few exceptions, definitely launched into civilian life.

Ship Versus Shore

Digested by the MILITARY REVIEW from an article by Bernard Stokes in "The Navy" (Great Britian) November 1946.

"SHIPS are unequally matched against forts. . . . A ship can no more stand up against a fort costing the same money than the fort could run a race with the ship." Centuries of warfare largely uphold Admiral Mahan's famous axiom, and the anniversary of the bombardment of Alexandria encourages an interesting comparison with modern conditions.

Arabi's insurgent activities brought the Mediterranean Fleet of eight ironclads and five gunboats to Alexandria under Admiral Sir Beauchamp Seymour. Action was joined on 11 July 1882 after repeated orders to the Egyptians to cease work on the harbor forts had been ignored.

While the ironclads *Penelope, Monarch,*

and *Invincible* opposed Fort Mex and the sandhill batteries, the *Alexandra*, *Superb*, and *Sultan*, opposed forts Ras-el-Teen, Ada and Pharos; the *Temeraire* and *Inflexible*, with her four 16-inch, 80-ton smooth-borne muzzle-loading guns, were in support.

At ranges from 3,500 to 5,000 yards the forts suffered severly from the heavy naval guns and despite the bravery of the gunners, were hammered to pieces and many of the guns silenced. Lacking experience of their huge Krupp guns, the Egyptians fired mainly too high, and the lighter pieces, though accurate, had little effect on the battleship's armor. Favored by the inexperience of their opponents, the ships emerged triumphant.

On 3 November 1914, the battle cruisers *Indomitable* and *Indefatigable* shelled Sedd-el-Bahr castle and the more modern Helles fort at long range, disabling several guns and damaging the forts. The French battleships *Suffren* and *Verite* were, however, less successful against the forts of Kum Kale and Orkanieh.

On 19 February 1915, the *Suffren* and *Gaulois* attacked Kum Kale, the *Cornwallis* and *Triumph* struck at Orkanieh and Helles, and the *Inflexible* hit Sedd-el-Bahr. Vice Admiral Carden ordered them to anchor after ninety minutes' ineffective work, hoping to attain greater accuracy. Under deliberate fire the forts remained silent. The ships closed in, and the *Vengeance* and *Cornwallis* tackled Orkanieh and Helles from about 8,000 yards. The *Vengeance* encountered heavy fire, but, apart from splinters, was unhurt, having given Orkanieh a severe hammering. HMS *Triumph* found Helles very hard to see and hit, but the battle crusier *Inflexible*, with twenty-one rounds at Helles, and nineteen at Orkanieh, badly rattled the enemy.

What was the exact result? Very small; sufficient accuracy was not attainable while under way, indirect fire was unreliable, and, despite devastated earthwork and emplacements, only direct hits on the weapons could silence the guns.

Long-range bombardment began on 25 February, and the new super-dreadnought *Queen Elizabeth* landed nine 15-inch shells on Helles, knocking out two guns, the *Agamemnon* received seven hits from Helles and the *Gaulois* one. The *Irresistible* hit the two 9.4-inch guns at Orkanieh.

The *Vengeance*, *Cornwallis*, *Suffren*, *Charlemagne*, *Albion* and *Triumph* silenced Seed-el-Bahr and Kum Kale with their secondary armaments, hitting guns at point-blank range. Sedd-el-Bahr, Kum Kale, Helles and Orkanieh were beaten. The howitzers and field guns still defeated the minesweeping trawlers.

Positive successes were the dismounting of Helles' two 9.4-inch guns, the destruction of one and the damaging of the other 9.4-inch in Orkanieh; otherwise the forts' temporary abandonment and structural damage mattered little.

Next day the *Albion* and *Majestic* tackled Fort Dardanos, whose steel-turreted 6-inch guns were never mastered.

Between 26 and 29 February, Marine landing parties demolished the remaining guns of Sedd-el-Bahr, Kum Kale, and Orkanieh—an admission that ships, unaided, could not silence the forts.

On 5 March the *Queen Elizabeth* fired indirectly across the peninsula at Fort 13 and in return received twenty hits from field artillery. Next day she similarly shelled Fort 20 with its two 14-inch weapons, was again hit, and many shells on the fort failed to silence the guns. Inadequate spotting hampered her severly.

On 18 March the *Queen Elizabeth* scored hits on Forts 19 and 20, but had her gun-room wrecked, while the *Gaulois*, hit by a 14-inch shell, retired listing, to beach herself on Drapand Island.

By 1 PM the *Inflexible* had received

nine hits; her forebridge and deckhouse were on fire, foretop communications wrecked, fire-control shattered. The *Agamemnon* was struck twelve times, but the forts were weakening when six British battleships relieved the French squadron.

As the latter withdrew the *Bouvet* struck a mine and sank with the loss of over 600 lives. The *Inflexible* hit a mine at 4 PM and reached Tenedos with great difficulty.

Fort 19 disabled the *Irresistible*, which drifted on to a mine, and was abandoned. The *Ocean*, attempting to tow her, had her steering gear disabled by a shell, struck another mine, and was likewise doomed.

For three capital ships sunk, three disabled and others damaged, thirty-five British and over 600 French killed, four enemy guns were knocked out, a magazine destroyed, and the forts left short of ammunition; but we were no nearer Constantinople.

Without mine damage, six out of sixteen battleships had been worsted in a gunnery duel—their damage was heavy—while the mines could not have been laid without the protecting forts. Of the seventeen heavy guns guarding the Narrows only four were temporarily crippled. From this stage the army took the leading part in operations.

The increased reliability of aircraft spotting has aided warships, as the result of which, Force "H" at Genoa, the Mediterranean Fleet at Bardi, Tripoli and Valona were able to create havoc among shore installations and troops.

Aircraft flares permit night bombardments by silhouetting targets for the ships which remain invisable save for their gun-flashes. Tripoli, Valona and Cherbourg were effectively shelled at night. Few straight duels with land forts have occurred in this war, but the navy has done great work in the support of the army. Silencing forts at Algiers and Oran and field batteries around Sicily, our battleships eased the infantry's task, while at Salerno the valiant close-range assault of battleships, cruisers and destroyers alone saved a Fifth Army debacle.

Off Normandy the battleships *Nelson*, *Rodney* and *Warspite*, the cruisers *Enterprise*, *Glasgow*, *Orion* and *Arethusa*, to mention only a few famous names, did mighty execution against coast guns, artillery batteries and tanks at ranges from 11½ to 20 miles. Such incredibly accurate fire at long ranges amazed our infantry. Naval forward observation officers contributed greatly to these shattering blows at the enemy.

Continental troops, it is well known, find a naval bombardment more terrifying and destructive than any other weapon. It is seldom realized that the firepower of a cruiser mounting twelve 6-inch guns equals a regiment of field artillery.

The advent of radar may weight the scales more in favor of the ships. In the main, Admiral Mahan's dictum holds good, but it is equally true that this war has closed the gap.

Before we cast away the solid assurance of national armaments for self-preservation, we must be certain that our temple is built not upon shifting sands or quagmires, but upon the rocks.

Winston Churchill